I. C. 6964

NOVEMBER 1937

UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
JOHN W. FINCH, DIRECTOR

INFORMATION CIRCULAR

# RECONNAISSANCE OF MINING DISTRICTS IN CLARK COUNTY, NEV.

RECEIVED
DEC [illegible]
O. S. U.

BY

WILLIAM O. VANDERBURG

AFTER THIS REPORT HAS SERVED YOUR PURPOSE AND IF YOU HAVE NO FURTHER NEED FOR IT, PLEASE RETURN IT TO THE BUREAU OF MINES, USING THE OFFICIAL MAILING LABEL ON THE INSIDE OF THE BACK COVER.

I. C. 6964
November 1937

# INFORMATION CIRCULAR

## DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

# RECONNAISSANCE OF MINING DISTRICTS IN CLARK COUNTY, NEV. [1]

By William O. Vanderburg [2]

## CONTENTS

Page

Introduction . . . . . . . . . . . . . . . . . . . . . . . . 4
Acknowledgments . . . . . . . . . . . . . . . . . . . . . . 4
Clark County . . . . . . . . . . . . . . . . . . . . . . . . 4
    Topography . . . . . . . . . . . . . . . . . . . . . 5
    Climate and desert vegetation . . . . . . . . . . 5
    Water resources . . . . . . . . . . . . . . . . . . 6
    Power facilities . . . . . . . . . . . . . . . . . 6
    Transportation facilities . . . . . . . . . . . . 7
    History of mining . . . . . . . . . . . . . . . . 8
    Mineral production . . . . . . . . . . . . . . . . 9
Mining Districts
    Alunite (gold) . . . . . . . . . . . . . . . . . . 12
        Quo Vadis group . . . . . . . . . . . . . . . 13
    Arden (gypsum, silica sand) . . . . . . . . . . . 13
        Blue Diamond Corporation, (Ltd.) . . . . . . 13
        Arden Silica Co. . . . . . . . . . . . . . . . 15
    Copper King (Key West) (copper-nickel-platinum, gold-silver-lead, mica, beryl, manganese) . . . . 16
        Key West mine. . . . . . . . . . . . . . . . . 16
        Great Eastern group . . . . . . . . . . . . . 18
        Other copper-nickel-platinum claims . . . . 18
        Mica and beryl claims. . . . . . . . . . . . 18
        Manganese deposit . . . . . . . . . . . . . . 19
    Crescent (gold, silver, turquoise, feldspar, fluorspar, mica) . . . . . . . . . . . . . . . . . . 19
        Nippeno group . . . . . . . . . . . . . . . . 20
        Budget group . . . . . . . . . . . . . . . . . 20
        Red Star group . . . . . . . . . . . . . . . . 21
        Lily group . . . . . . . . . . . . . . . . . . 22
        Double Standard group. . . . . . . . . . . . 23
        Colonel Sellers claim. . . . . . . . . . . . 23

---

[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6964."

[2] Mining engineer, Metal Mining Methods Section, Mining Division, U. S. Bureau of Mines.

## CONTENTS (Cont'd)

Page

Mining Districts (Cont'd)

Crescent (gold, silver, turquoise, feldspar, fluorspar, mica) (Cont'd)

- Cumberland group . . . . . . . . . . . . . . . . 24
- Turquoise deposits . . . . . . . . . . . . . . . 24
- Feldspar deposit . . . . . . . . . . . . . . . . 25
- Fluorspar deposits . . . . . . . . . . . . . . . 25
- Mica deposit . . . . . . . . . . . . . . . . . . 25

Eldorado (Colorado) (gold, silver) . . . . . . . 26
- Eldorado Canyon Development Co. . . . . . . . 27
- Diamond Gold Mining Co. . . . . . . . . . . . 30
- Eldorado Rover Mining Co. . . . . . . . . . . 31
- Eldorado Rand mine . . . . . . . . . . . . . . 31
- Crown Queen group . . . . . . . . . . . . . . . 32
- Eldorado Empire Mining Co. . . . . . . . . . . 32
- Golden Empire group . . . . . . . . . . . . . . 33
- Other properties . . . . . . . . . . . . . . . 33

Gold Butte (gold, zinc, copper, mica, magnesite). 34
- Lake Shore Mining Co.. . . . . . . . . . . . . 34
- Azure Ridge group . . . . . . . . . . . . . . . 36
- Webster group . . . . . . . . . . . . . . . . . 36
- Mica deposits . . . . . . . . . . . . . . . . . 36
- Magnesite deposit . . . . . . . . . . . . . . . 37

Goodsprings (Yellowpine) (zinc, lead, copper, gold, silver, molybdenum, vanadium, cobalt, platinum) . . . . . . . . . . . . . . . . . . . . 37
- Zinc-lead-silver and copper . . . . . . . . . 41
  - Yellow Pine Mining Co. . . . . . . . . . . 41
- Gold and platinum . . . . . . . . . . . . . . 42
  - Keystone-Barefoot mine . . . . . . . . . . 43
  - Boss mine . . . . . . . . . . . . . . . . . 44
  - Chiquita mine . . . . . . . . . . . . . . . 45
  - Red Cloud group . . . . . . . . . . . . . . 46
  - Other mines . . . . . . . . . . . . . . . . 47
- Molybdenum . . . . . . . . . . . . . . . . . . 48
  - Shenandoah mine . . . . . . . . . . . . . . 48
- Vanadium. . . . . . . . . . . . . . . . . . . 49
  - Spelter group . . . . . . . . . . . . . . . 50
  - Hoodoo group . . . . . . . . . . . . . . . 50
  - Whale group . . . . . . . . . . . . . . . . 50
  - Valley Forge group . . . . . . . . . . . . 51
  - Velvet group. . . . . . . . . . . . . . . . 51
  - Akron group . . . . . . . . . . . . . . . . 52
- Cobalt. . . . . . . . . . . . . . . . . . . . 52
  - Swansea group . . . . . . . . . . . . . . . 52

Jean (silica sand, radium, limestone) . . . . . 53
- Nevada Pacific Minerals Co. . . . . . . . . . 53
- Radium deposits . . . . . . . . . . . . . . . 54
- Limestone deposit . . . . . . . . . . . . . . 54

## CONTENTS (Cont'd)

Page

Mining Districts (Cont'd)
- Las Vegas (manganese) . . . . . . . . . . . . . . . 54
  - Boulder Dam Manganese Co. . . . . . . . . . 54
  - Ebony Queen claim . . . . . . . . . . . . . 56
- Moapa (gypsum, volcanic ash) . . . . . . . . . . 56
  - Gypsum deposits . . . . . . . . . . . . . . 56
  - Volcanic ash deposit . . . . . . . . . . . . 57
  - Tin deposit . . . . . . . . . . . . . . . . 57
- Muddy Mountains (borates, gypsum, silica sand, bentonite, sodium sulphate) . . . . . . . . . . . 57
  - Borate deposits . . . . . . . . . . . . . . 58
  - Gypsum deposits . . . . . . . . . . . . . . 60
  - Silica-sand deposits . . . . . . . . . . . . 60
  - Bentonite deposits . . . . . . . . . . . . . 61
  - Sodium sulphate deposit . . . . . . . . . . 61
- St. Thomas (Virgin River) (silica sand, magnesite, gypsum, salt, sodium sulphate) . . . . 61
  - Morledge & Veitch Co. . . . . . . . . . . . 62
  - Nevada Silica Sand Co. . . . . . . . . . . . 64
  - Other silica-sand deposits . . . . . . . . . 65
  - Magnesite deposits . . . . . . . . . . . . . 66
  - Gypsum deposits . . . . . . . . . . . . . . 67
  - Salt deposits. . . . . . . . . . . . . . . . 67
  - Sodium sulphate (glauberite) deposit . . . 68
- Searchlight (gold, silver) . . . . . . . . . . 68
  - Custom milling . . . . . . . . . . . . . . . 69
  - Blossom mine . . . . . . . . . . . . . . . . 69
  - Quartette mine . . . . . . . . . . . . . . . 73
  - Chief of the Hills mine . . . . . . . . . . 74
  - Duplex Mining Co. . . . . . . . . . . . . . 74
  - Southern Nevada group . . . . . . . . . . . 75
  - Pompeii group . . . . . . . . . . . . . . . 75
  - Black Mountain Mining Co. . . . . . . . . . 76
  - Goldenrod group . . . . . . . . . . . . . . 76
  - Jackdaw group . . . . . . . . . . . . . . . 76
  - Homestake group . . . . . . . . . . . . . . 77
  - Other properties . . . . . . . . . . . . . . 77
- Sloan (limestone, dolomite, radium) . . . . . . 78
  - U. S. Lime Products Corporation . . . . . 79
  - Carnotite deposit . . . . . . . . . . . . . 80
- Sunset (gold, feldspar) . . . . . . . . . . . . 80
  - Lucy Gray mine . . . . . . . . . . . . . . . 81
  - Feldspar deposits . . . . . . . . . . . . . 81

## INTRODUCTION

This paper [3] gives the results of a reconnaissance of mining districts in Clark County, Nev., made from November 18 to December 22, 1936, and from February 9 to March 8, 1937—in all, 63 days. While the field work was being done, virtually all of the mining districts in the county were visited and many data on active and inactive properties were obtained. The report covers the locations of the various mining districts, the nature of the deposits, information on past operations, current activity, and general data likely to be useful to operators, investors, and others interested in mining. The geology of the deposits is discussed only briefly.

The principal metal-mining districts in the county are Goodsprings, Eldorado, and Searchlight. The zinc-lead ores of Goodsprings have been the most important economically, followed by the gold-silver ores of Eldorado and Searchlight. In the industrial-mineral field, gypsum, limestone, silica sand, and borates are the principal products.

Metal mining in the county is characterized by numerous small operations, and the ores are either milled locally or shipped to distant smelters.

## ACKNOWLEDGMENTS

Thanks are due Frank Williams, Yeoman Briggs, and Albert C. Calkins, who gave assistance and information during the field work in the Goodsprings, Nelson, and Searchlight districts, respectively, and other owners, operators, and lessees too numerous to mention individually.

Charles White Merrill, supervising engineer, San Francisco office, Mineral Production and Economics Division, United States Bureau of Mines, furnished the data for the mineral-production tables, and the Mackay School of Mines, University of Nevada, at Reno, cooperated in making mineral determinations and assays and offering the use of its technical library.

## CLARK COUNTY

Clark County, in southeastern Nevada, was organized and created from that portion of Lincoln County lying south of the third standard parallel south of the Mount Diablo base line, by an act of the State legislature approved February 5, 1908. By this act the place formerly known as Clark's Las Vegas Townsite was renamed Las Vegas and made the county seat. The county has an area of 8,045 square miles, or approximately that of Massachusetts (8,266 square miles) or New Jersey (8,224 square miles).

According to the census of 1930, the population of the county was 8,532, the majority residing in Las Vegas. The principal industries are agriculture, stock-raising, and mining.

---

[3] Manuscript completed April 12, 1937.

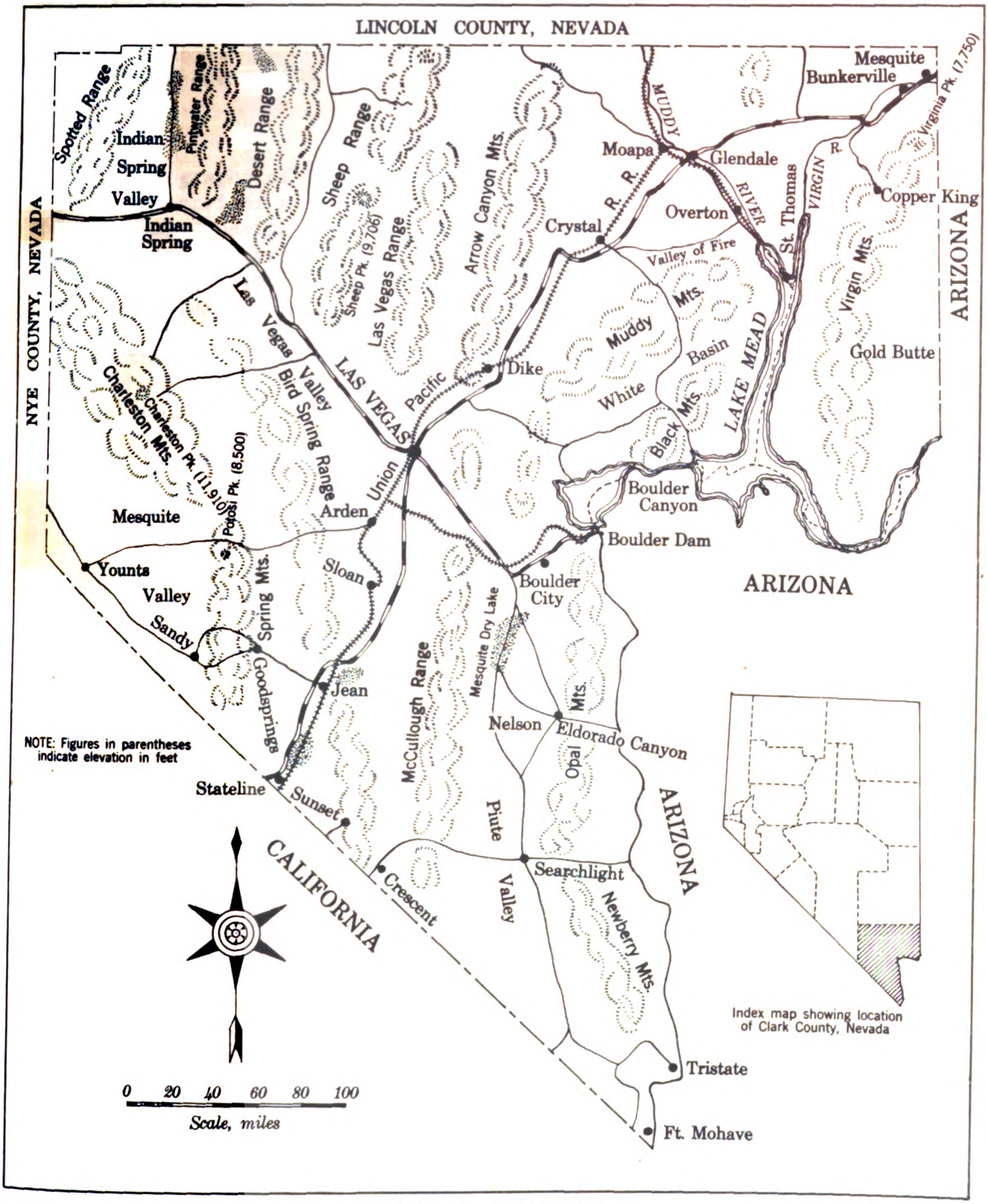

Figure 1.—Sketch map of Clark County, Nev.

The assessed value of real property for the fiscal year 1935-36 was $14,552,500. The county and State tax rate for that year was $2.52 per $100, exclusive of special taxes.

A sketch map of the county is shown in figure 1.

## Topography

The topography of Clark County is characteristic of the Great Basin region and comprises a series of broad valleys between more or less parallel mountain ranges having a north-south trend. Most of the ranges are short; few extend in an unbroken chain more than 30 miles. The most prominent ranges are Charleston, Spring Mountain, Sheep, Las Vegas, McCullough, Opal Mountains, Muddy Mountains, and Virgin Mountains. In general the altitude is from 3,000 to 6,000 feet, although isolated peaks are higher. Charleston Peak, in the Charleston Range, the highest point in Clark County and the third highest mountain in the State, has an altitude of 11,910 feet; Sheep Peak (not to be confused with Sheep Mountain near Jean, Nev.), in the Sheep Mountains, is 9,706 feet high; Potosi Peak, in the Spring Mountain Range, is 8,500 feet; and Virgin Peak, in the Virgin Range, is 7,750 feet. Only a few of the mountain ranges have form sufficiently striking to give them individuality, and with the exception of the higher slopes in the Charleston, Spring Mountain, and Virgin Ranges are virtually barren of timber growth.

The altitude of the lower parts of the valleys ranges from 2,000 to 3,000 feet. The principal valleys are Indian Spring, Las Vegas, Muddy River, Piute, and the Virgin River.

## Climate and Desert Vegetation

Clark County, with its limited rainfall and abundant sunshine, is one of the driest areas in the United States. During the summer the weather is quite warm, and a temperature above 110° in the middle of the day is not uncommon. However, the humidity is so low that a high temperature can be endured with less physical discomfort than with a lower temperature but higher humidity. In the valleys light snowfalls may occur, but the snow seldom stays on the ground more than a few days. In virtually all the districts mentioned in this report mining can be carried on the year around without difficulty.

Some kind of vegetation is prevalent over the whole area, with the exception of the lower parts of the valleys that have alkaline soil injurious to vegetation. On the higher mountain slopes there are growths of cedar, piñon pine, mountain mahogany, and some spruce. Among the common desert growths at lower elevations are the creosote bush (Covillea tridentata), greasewood (Atreplex canescens), sagebrush (Artemesia tridentata), Joshua tree (Yucca arborescens), and a great variety of plants from the Cactaceae family. The Yucca, sometimes mistaken for a cactus, belongs to the lily family.

The Cactaceae are particularly interesting, as they occur in greater number and variety in southern Clark County than in any other part of the State. Among the more common varieties are the fox-tail (Coryphantha deserti), California pin-cushion, (Mammillaria tetrancistera), the hedgehog (Echinocereus mojavensis), Indian strawberry (Echinocereus Engelmannii), beaver-tail prickly pear (Opuntia basilaris), flapjack prickly pear (Opuntia chlorotica), porcupine prickly pear (Opuntia hystricina), buckhorn cholla (Opuntia asanthocarpa), golden-spined jumping cholla (Opuntia Bigelovii), nigger-head (Echinocactus Le Contei), California barrel cactus (Echinocactus acanthodes), fishhook cactus (Echinocactus polyancistrus), and harem cactus (Echinocactus polycephalus). The barrel cacti are particularly interesting to the desert traveler, for many a life has been saved by the cooling, refreshing water stored within the pulpy interior.

## Water Resources

The only large body of water in Clark County is Lake Mead, formed by Boulder Dam. When the water reaches the crest of the dam it will back up the Colorado River about 115 miles and have an area of 227 square miles. The water supply for Boulder City is obtained from this lake; it is filtered and chlorinated for domestic use.

Water for domestic use in Las Vegas and for irrigation is obtained from artesian wells in Las Vegas Valley. The artesian basin has an area of 100 square miles, and in it there are 300 wells 300 to 1,100 feet deep. One of the wells owned by the Union Pacific R.R. is 650 feet deep and flows 3 1/2 million gallons per day.

The only areas in the county where enough water is available for irrigation are the Las Vegas, Virgin, and Muddy River Valleys. The Virgin River rises in the mountains in southwestern Utah and flows southwesterly across the corner of Arizona into Nevada, emptying into Lake Mead. Its principal tributary is the Muddy River, which has its source in Lincoln County, Nev. It flows almost due south, joining the Virgin River a little below St. Thomas, Nev. These rivers supply water to irrigate only small portions of the very fertile valleys bearing their names. The chief crops are cantaloupes, tomatoes, alfalfa, and various truck-garden products.

In the valleys, the precipitation is 2 to 3 inches per year. The amount of precipitation increases progressively with the elevation, and in the higher mountains it is considerably more. Cloudbursts that may do considerable damage sometimes occur during the summer months.

In the Goodsprings district, water for mining and milling is available from shallow wells; in the Searchlight district, from mine workings; and in the Eldorado district, from the Colorado River about 7 miles east.

## Power Facilities

Clark County has no public-service power company at present, and all the mining districts depend upon either Diesel or gasoline engines for power. Work on Boulder Dam, on the Colorado River at Black Canyon, 25 miles southeast of Las Vegas, was begun officially on July 7, 1930, and was virtually completed in 1936. Installed hydraulic turbine capacity at the dam will be 1,850,000 horsepower, of which the firm output is estimated to be 663,000 horsepower. Eighteen percent of the firm power can be withdrawn for use in Nevada, subject to 6 months to 2 years notice on contract, depending upon the amount withdrawn.

The Southern Sierras Power Co. owns a 132-kv transmission line from the Dam to southern California, and the City of Los Angeles has two 278.5-kv transmission lines to Los Angeles. A transmission line to Pioche, Nev., is now under construction.

A number of problems connected with the use of Nevada's allotment of power have not been worked out, and the interested reader is referred to the report of the Colorado River Commission of Nevada 4/.

## Transportation Facilities

Las Vegas is on U. S. Route 91 (Arrowhead Trail), which connects Salt Lake City, Utah, and Los Angeles, Calif. This highway is oil-surfaced and traverses the county northeast and southwest. Other oiled roads connect Las Vegas with Boulder City and points south, via the road over Boulder Dam; Las Vegas with Beatty, Nev., and points north; and Glendale, on U. S. Route 91, with Overton, Nev. All the other roads in the county are either gravel or natural and afford easy access by automobile to all the districts mentioned in this report, except the territory between the Virgin River and the Arizona-Nevada boundary. Here the roads are in poor condition and in places virtually impassable.

The Western Air Express operates three planes daily between Salt Lake City and Los Angeles, stopping at Las Vegas enroute.

The trunk line of the Union Pacific R.R. connecting Salt Lake City with Los Angeles traverses the county in a northeast-southwest direction, roughly paralleling U. S. Route 91. A branch line extends from Las Vegas to Boulder City and another from Moapa to a point several miles south of Overton. The freight rates on ores from various points in Clark County to Salt Lake Valley smelters are shown in the following table.

---

4/ Report of the Colorado River Commission of Nevada to Gov. Richard Kirman and the Nevada State Legislature, period Sept. 1, 1935, to Jan. 1, 1937, Alfred Merritt Smith, Secy.

| Value of ore per ton | $15 | $20 | $30 | $40 | $50 | $60 | $70 | $80 | $90 | $100 |
|---|---|---|---|---|---|---|---|---|---|---|
| Roach . . . . | 4.00 | 4.00 | 4.50 | 5.00 | 6.60 | 7.30 | 8.00 | 8.70 | 9.40 | 10.10 |
| Jean. . . . . | 4.00 | 4.00 | 4.50 | 5.00 | 6.60 | 7.30 | 8.00 | 8.70 | 9.40 | 10.10 |
| Sloan . . . . | - | - | - | - | - | - | - | - | - | 2/ 9.75 |
| Arden . . . . | - | - | - | - | - | - | - | - | - | 2/ 9.75 |
| Las Vegas . . | - | - | - | - | - | - | - | - | - | 2/ 9.75 |
| Boulder City. | - | - | - | - | 6.30 | 6.80 | 7.30 | 7.80 | 8.30 | 8.80 |
| Moapa 1/. . . | - | - | - | - | 6.30 | 6.80 | 7.30 | 7.80 | 8.30 | 8.80 |
| Arrowhead 1/. | - | 5.29 | 6.30 | 7.43 | 8.44 | 9.11 | 9.45 | 9.90 | 10.24 | 10.58 |
| St. Thomas. . | - | 5.29 | 6.30 | 7.43 | 8.44 | 9.11 | 9.45 | 9.90 | 10.24 | 10.58 |

NOTE: Minimum weight, 40,000 lb., unless otherwise specified.
1/ Minimum weight, 80,000 lb.
2/ Minimum weight, 60,000 lb.

The freight rates shown in the table do not apply to industrial minerals, since it is the practice of railroads to give special consideration to enterprises that can supply a large and steady tonnage, and such rates are determined largely by competitive conditions.

## History of Mining

Nevada was part of the territory acquired from Mexico in 1848 by the treaty of Guadalupe-Hidalgo. In 1850 it was made a part of the Territory of Utah. By Act of Congress, approved March 2, 1861, the Territory of Nevada was created, and on October 31, 1864 it was admitted into the Union.

Clark County is one of the oldest sections of Nevada, and the first mining in this area was done by Indians who settled in the Muddy and Virgin River Valleys at the dawn of the Christian era. Archeological investigations at Pueblo Grande de Nevada (The Lost City) near St. Thomas show that these ancient inhabitants reached a fairly high stage of civilization. Their homes, burials, and specimens of their culture may be seen in the Lost City museum a short distance south of Overton. The mining activities of this aboriginal race were confined largely to the exploitation of the Virgin River salt deposits (probably for trade purposes) and for turquoise. Pipes and other articles made from soapstone have been found also.

The earliest white men in Nevada were the Franciscan monks, who passed through Clark County on their way from Mexico to California as early as the middle of the eighteenth century. There is some evidence to show that a little mining was done by Spanish explorers, who followed in the trails of the Franciscan fathers.

Southern Nevada was colonized by the Mormons in 1850, and settlements were established at Las Vegas, Callville, and along the Muddy and Virgin Rivers. Aside from the mines of the Indians and Spanish explorers, the Potosi mine in the Goodsprings district is the oldest lode mine in the State. It was discovered in 1855 by some of the Mormons who returned from San Bernardino, Calif. According to Helen J. Stewart[5],

> A man by the name of Slade was made superintendent of the Potosi mine in 1855, having been sent out by the church authorities to supervise the lead mining. They made an attempt to smelt the ore at the mine, using pitch-pine for fuel, with no result save badly burned hands. They also tried cedar wood for that purpose, which was better, but still not successful. Not being satisfied with the results, they brought their ore down to the Las Vegas rancho. Dudd Leavitt and Isaac Grundy here built a furnace in a fireplace, using the chimney for making a draft. When the ore became too hot they devised the plan of placing an adobe brick in the furnace to even the temperature. In this crude way they succeeded in making a success of their smelting operations. They moulded their lead in an old iron skillet which gave the bars the appearance of miners' loaves of bread. In this manner they prepared and sent to Cedar City, Utah, ten thousand pounds of lead, which was put in charge of Bishop Smith and by him distributed.

Notwithstanding this early discovery, little attention was paid to the mining of base metals until 45 years later.

The first systematic mining in Clark County began with the discovery of gold-silver deposits in the Eldorado (Colo.) district in 1857. As this district was on a natural travel route (the Colorado River), it was actively exploited. This discovery was followed by the discovery of the Keystone mine in the Goodsprings district in 1892 and mines in the Searchlight area in 1897.

In 1905 the San Pedro, Los Angeles & Salt Lake R.R. was completed and the town of Las Vegas established. The completing of this railroad stimulated the mining of zinc, lead, and copper deposits in the Goodsprings district, and the greatest activity occurred here during the war, when the price of base metals became very high.

The exploitation of nonmetallic deposits in the county began about 1910. In recent years most of the metal mining has been done by lessees and small companies, principally of gold and silver deposits.

## Mineral Production

The annual metal production of Clark County from 1908 to 1934 is shown in table 1. Nearly all the metal shown in the table was produced in three districts; the gold and silver came principally from Searchlight and Eldorado, and the copper, lead, and zinc from Goodsprings. Other metals

---

[5] Stewart, Helen J., History of Nevada: Edited by Samuel P. Davis, vol. 1 1913, pp. 217-218.

TABLE 1. - Metal production, Clark County, 1908-1935.

| Year | Gold |  | Silver |  | Copper |  |
|---|---|---|---|---|---|---|
|  | Fine ounce | Value | Fine ounce | Value | **Pounds** | Value |
| 1908.... | 13,553.03 | $ 280,166 | 21,213 | $ 11,243 | 62,719 | $ 8,279 |
| 1909.... | 16,594.41 | 343,037 | 35,294 | 18,353 | 23,308 | 3,030 |
| 1910.... | 10,603.36 | 219,191 | 30,650 | 16,551 | 216,773 | 27,530 |
| 1911.... | 1,229.40 | 25,414 | 55,643 | 29,491 | 185,915 | 23,239 |
| 1912.... | 2,401.43 | 1/ 49,740 | 236,465 | 145,426 | 173,887 | 28,692 |
| 1913.... | 6,970.35 | 144,090 | 198,922 | 120,149 | 351,855 | 54,537 |
| 1914.... | 4,468.74 | 92,377 | 127,233 | 70,360 | 188,154 | 25,025 |
| 1915.... | 8,109.54 | 167,639 | 160,749 | 81,500 | 301,327 | 52,732 |
| 1916.... | 14,912.66 | 308,272 | 404,788 | 266,351 | 573,088 | 140,980 |
| 1917.... | 10,599.88 | 219,119 | 319,836 | 263,545 | 878,646 | 239,870 |
| 1918.... | 8,391.95 | 173,477 | 252,694 | 252,694 | 467,486 | 115,469 |
| 1919.... | 7,016.45 | 145,043 | 258,288 | 289,283 | 148,469 | 27,615 |
| 1920.... | 5,870.69 | 121,358 | 186,945 | 203,770 | 121,508 | 22,357 |
| 1921.... | 3,602.78 | 74,476 | 12,094 | 12,094 | 31,247 | 4,031 |
| 1922.... | 1,668.21 | 34,485 | 11,682 | 11,682 | 12,899 | 1,741 |
| 1923.... | 1,093.03 | 22,595 | 36,669 | 30,069 | 24,005 | 3,529 |
| 1924.... | 1,838.59 | 38,007 | 127,182 | 85,212 | 23,257 | 3,047 |
| 1925.... | 3,867.48 | 79,948 | 78,418 | 54,422 | 22,610 | 3,211 |
| 1926.... | 3,275.86 | 67,718 | 39,121 | 24,412 | 21,240 | 2,974 |
| 1927.... | 1,286.39 | 26,592 | 15,843 | 8,983 | 9,879 | 1,294 |
| 1928.... | 749.52 | 15,494 | 27,805 | 16,226 | 118,085 | 17,004 |
| 1929.... | 1,566.29 | 32,378 | 21,022 | 11,205 | 47,000 | 8,272 |
| 1930.... | 1,368.77 | 28,295 | 6,565 | 2,527 | 18,346 | 2,385 |
| 1931.... | 5,659.39 | 116,990 | 12,662 | 3,672 | 8,887 | 809 |
| 1932.... | 3,100.93 | 2/ 66,419 | 8,592 | 2,423 | 4,353 | 274 |
| 1933.... | 1,866.83 | 3/ 39,424 | 5,038 | 1,763 | 4,201 | 269 |
| 1934.... | 3,906.26 | 4/136,926 | 19,783 | 12,789 | 10,352 | 828 |
|  | 145,572.22 | 3,068,670 | 2,711,196 | 2,046,195 | 4,049,496 | 819,023 |

1/ Includes placer gold valued at $ 98.
2/ Includes placer gold valued at $2,317.
3/ Includes placer gold valued at $1,035.
4/ Includes placer gold valued at $402.

TABLE 1. - Metal production, Clark County, 1908-1935 (Continued)

| Year | Lead |  | Zinc |  | Total value |
|---|---|---|---|---|---|
|  | Pounds | Value | Pounds | Value |  |
| 1908.... | 765,142 | $ 32,136 | 1,115,851 | $ 52,445 | $ 384,269 |
| 1909.... | 445,907 | 19,174 | 3,013,352 | 162,721 | 546,315 |
| 1910.... | 1,309,684 | 57,626 | 2,707,071 | 146,182 | 467,080 |
| 1911.... | 1,629,571 | 73,331 | 3,548,032 | 202,238 | 353,713 |
| 1912.... | 6,555,565 | 295,000 | 13,254,860 | 914,585 | 1,433,443 |
| 1913.... | 6,265,783 | 275,694 | 14,369,709 | 804,704 | 1,399,174 |
| 1914.... | 4,207,419 | 164,090 | 11,862,149 | 604,970 | 956,822 |
| 1915.... | 4,655,985 | 218,832 | 21,061,182 | 2,611,587 | 3,132,290 |
| 1916.... | 8,405,796 | 580,000 | 29,400,537 | 3,939,672 | 5,235,275 |
| 1917.... | 9,373,817 | 806,148 | 20,660,549 | 2,107,376 | 3,636,058 |
| 1918.... | 6,541,129 | 464,420 | 15,472,155 | 1,407,966 | 2,414,026 |
| 1919.... | 4,257,114 | 225,627 | 5,974,219 | 436,118 | 1,123,686 |
| 1920.... | 4,018,864 | 321,509 | 9,381,503 | 759,902 | 1,428,896 |
| 1921.... | 284,217 | 12,790 | 69,397 | 3,470 | 106,861 |
| 1922.... | 360,500 | 19,827 | 891,174 | 50,797 | 118,532 |
| 1923.... | 1,519,764 | 106,384 | 8,755,427 | 595,369 | 757,946 |
| 1924.... | 7,764,771 | 621,182 | 7,909,042 | 514,088 | 1,261,536 |
| 1925.... | 5,409,440 | 470,621 | 6,230,664 | 473,530 | 1,081,732 |
| 1926.... | 2,044,599 | 163,568 | 2,210,162 | 165,762 | 424,434 |
| 1927.... | 1,690,443 | 106,498 | 3,546,078 | 226,949 | 370,316 |
| 1928.... | 2,220,320 | 128,779 | 1,425,285 | 86,942 | 264,445 |
| 1929.... | 1,080,457 | 68,069 | 1,236,702 | 81,622 | 201,546 |
| 1930.... | 966,686 | 48,334 | 2,474,323 | 118,768 | 200,309 |
| 1931.... | 796,107 | 29,456 | 1,899,328 | 72,174 | 223,101 |
| 1932.... | 450,752 | 13,523 | 254,795 | 7,644 | 90,283 |
| 1933.... | 75,631 | 2,798 | 23,346 | 981 | 45,235 |
| 1934.... | 154,437 | 5,714 | 28,635 | 1,231 | 157,488 |
|  | 83,249,900 | 5,331,130 | 188,775,527 | 16,549,793 | 27,814,811 |

produced in commercial quantities are manganese, vanadium, molybdenum, cobalt, platinum, and palladium. Turquoise has also been produced for semiprecious gem stones.

The county has also produced considerable tonnages of certain industrial minerals. Production statistics of these minerals are not available, but from information gathered in the field past production is estimated as follows: Limestone and dolomite, 1,500,000 tons; gypsum, more than 1,000,000 tons; silica sand, 200,000 tons; borates (colemanite), 200,000 tons ($B_2O_3$ content about 20 percent); and small amounts of rock salt and feldspar. Large reserves of the foregoing industrial minerals occur in the county, and while some of the deposits have little commercial importance at the present time on account of transportation difficulties and distance from consuming centers, they constitute valuable sources of supply for future needs.

Extensive reserves of magnesite occur in the St. Thomas district, but the material contains too great a percentage of impurities for commercial use. To utilize this magnesite on a large scale as a source of magnesium or for other purposes, research work is necessary.

In February 1937 the writer estimates that 360 men were directly employed in the mining industries of the county; two-thirds of these were employed in metal mining and one-third in the production of nonmetallic minerals.

## ALUNITE DISTRICT

### (Gold)

The Alunite district is in central Clark County 3 to 5 miles west of Boulder City, the nearest railroad point. In 1908, gold was found here by Robert T. Hill, and the Alunite Mining Co. was organized to prospect in this area. The country rock is generally alunitized, and it was thought that because of the similarilty in rock alteration to the Goldfield district important gold deposits would be found. Although considerable exploration was done, this company did not find anything of importance.

The alunite of potash variety is widely disseminated in the country rock as well as in small veins. The district has been examined on several occasions as a source of potash, but on the average the alunite is too low grade to be of commercial importance at present. Samples taken by Gale [6] indicate that the average $K_2O$ content is probably 2 1/2 to 3 1/2 percent.

There is no record of production from this district, but the Quo Vadis property is reported to have made several small shipments of very high grade ore. This property was first worked in 1915 by a company called the Quo

---

[6] Gale, H. S., in Phalen, W. C., Potash Salts: U. S. Geol. Survey Mineral Resources, 1915, pt. 2, 1917, pp. 111-112.

Vadis Gold Mining Co. In February 1937 a small company called the Boulder Canyon Gold Mining Co. was preparing to prospect the Quo Vadis property.

### Quo Vadis Group

The Quo Vadis property comprises a group of five unpatented claims owned by E. W. Clark, of Las Vegas, Nev., and associates.

Development work consists of a 1 1/2-compartment vertical shaft 90 feet deep and an adit 300 feet long. Mining equipment includes a Gardner-Rix compressor (6 by 6 inches) driven by a Buick automobile engine, a 15-horsepower Fairbanks-Morse geared hoist, mining tools, and blacksmith shop.

Rich stringers of free-milling gold ore occur in biotite monzonite formation. The gangue is chiefly quartz and calcite stained with manganese. A small amount of silver is associated with the gold.

## ARDEN DISTRICT

### (Gypsum, Silica Sand)

Gypsum deposits occur in the Spring Mountains 5 to 13 miles west of Arden, Nev., a station on the Union Pacific R.R. Gypsum was mined in this locality by the Arden Plaster Co. from about 1909 to 1919. In 1919 the holdings of the Arden Plaster Co. were purchased by the United States Gypsum Co., and the latter company operated until 1931, when the mine and mill closed because the deposit was exhausted. The plaster mill at Arden is still intact, but much of the equipment is either in poor condition or obsolete. In 1925 the Blue Diamond Corporation, Ltd., began mining a gypsum deposit 13 miles westerly from Arden. This company has operated steadily and in 1936 was the only active producer of gypsum in the district. Adjoining the Blue Diamond mine is the Mateucci gypsum deposit, which has never been exploited. This property is reported to contain large reserves of gypsum comparatively free from anhydrite and of excellent grade.

Statistics on the production of gypsum from the Arden deposits are not available, but judging from the extent of the workings production has probably exceeded 1,000,000 tons.

Unlimited reserves of silica sand suitable for molding purposes occur west of Arden. Molding sand has been produced on a small scale from this deposit by the Arden Silica Co. for several years.

### Blue Diamond Corporation, Ltd.

The property of the Blue Diamond Corporation, Ltd., comprises about 1,000 acres, one-third of which is covered by a gypsum deposit. The company employs an average of 35 men in the production of about 300 tons of gypsum per day. The gypsum is crushed and screened at the mine and is shipped to southern California for use in cement and building industries.

The following data on operations were obtained from a report by Bradley [7] and from notes taken by the writer on a visit to the property late in 1936.

The main gypsum deposit occurs in a nearly horizontal sedimentary bed ranging from 12 to 20 feet in thickness and covered by strata of limestone and sandstone and irregular beds of gypsum. The overburden ranges from a few feet to 100 feet, and in the thickest portions the main gypsum bed contains masses of anhydrite. Directly overlying the gypsum bed is a layer of gypseous clay about 2 feet thick, which has enough strength to support the overburden and permit a room-and-pillar system of mining. The footwall is limestone and the parting between it and the gypsum bed is distinct. The gypsum analysis is as follows:

| | Percent |
|---|---|
| $CaSO_4$ .............. | 78.43 |
| $SiO_2$ ............... | .65 |
| $MgCO_3$ .............. | .25 |
| $Al_2O_3$;$Fe_2O_3$ ........ | .02 |
| $H_2O$ ................ | 20.65 |
| Total .............. | 100.00 |

Mining is done either by room-and-pillar or by open-cut methods, depending on the depth of overburden. In the open-cut system of mining the overburden is broken by blasting and shoveled into 5 1/2-ton-capacity dump trucks with a 3/4-cubic-yard-capacity Osgood gasoline shovel. The trucks haul the material to the nearest convenient dumping site, which is usually not more than a few hundred yards. The stripping depth depends upon the thickness of the gypsum bed; ratio of the gypsum mined to the overburden removed is, roughly, 1 to 1.

A sketch of the room-and-pillar method of mining is shown in figure 2. The rooms range from 25 to 40 feet in width and average about 12 feet in height. Pillars are left at intervals of about 35 feet. Drilling is done with jackhammers and 7/8-inch hollow hexagonal steel. About 28 holes, 8 feet deep, are required in each heading per round. Blasting is done with 40-percent gelatin dynamite and electric detonators. Air for drilling is furnished by two Chicago pneumatic compressors each 10 by 12 inches in size.

The broken gypsum is shoveled by hand into bottom-dump cars that hold 2.4 tons each. A small amount of waste, mostly anhydrite, is sorted out by hand. The anhydrite is readily distinguishable from the gypsum because of the difference in its color and texture. It is hauled to the crushing plant, about 1/4 mile distant, in trains of 8 cars drawn by a Plymouth gasoline

---

[7] Bradley, W. G., Methods and Costs of Mining and Crushing Gypsum at the Mine of the Blue Diamond Corporation, Ltd., Arden, Nev.: Inf. Circ. 6615, Bureau of Mines, 1932, 10 pp.

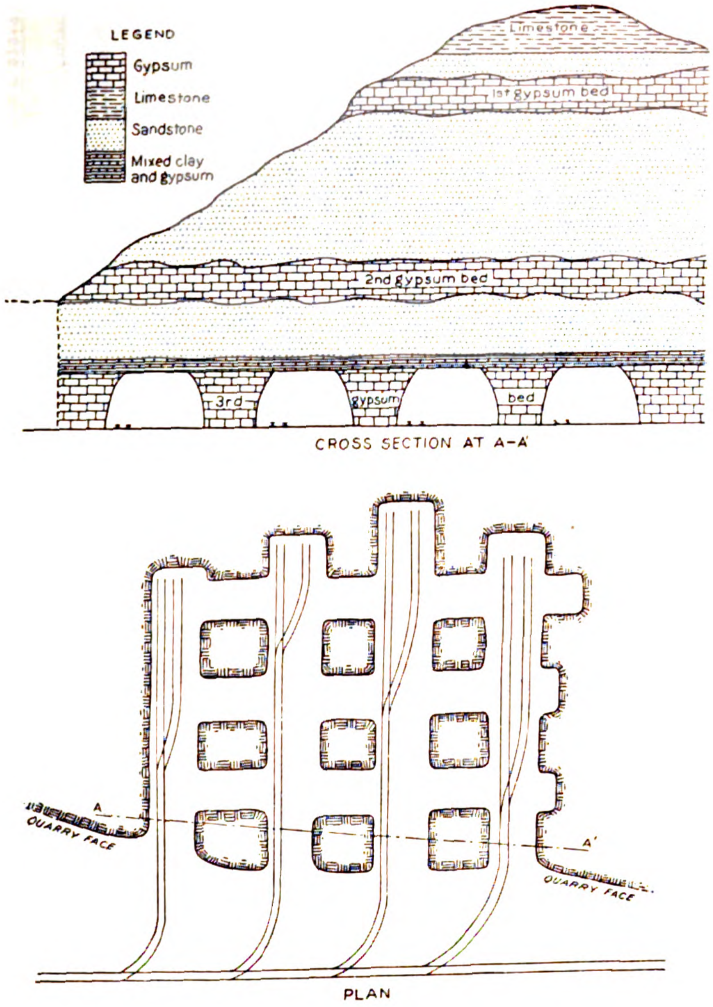

**Figure 2.—Cross section and plan of room-and-pillar workings, Blue Diamond Corporation. Ltd., Arden, Nev.**

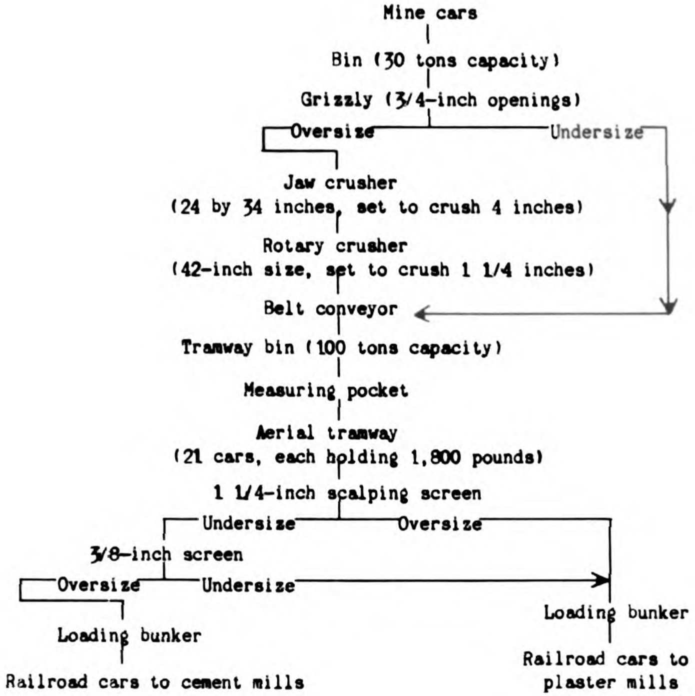
Mine cars
Bin (30 tons capacity)
Grizzly (3/4-inch openings)
Oversize
Undersize
Jaw crusher
(24 by 34 inches, set to crush 4 inches)
Rotary crusher
(42-inch size, set to crush 1 1/4 inches)
Belt conveyor
Tramway bin (100 tons capacity)
Measuring pocket
Aerial tramway
(21 cars, each holding 1,800 pounds)
1 1/4-inch scalping screen
Undersize
Oversize
3/8-inch screen
Oversize
Undersize
Loading bunker
Loading bunker
Railroad cars to cement mills
Railroad cars to plaster mills

Figure 3.- Flow sheet of crushing and screening plant, Blue Diamond Corporation, Ltd., Arden, Nev.

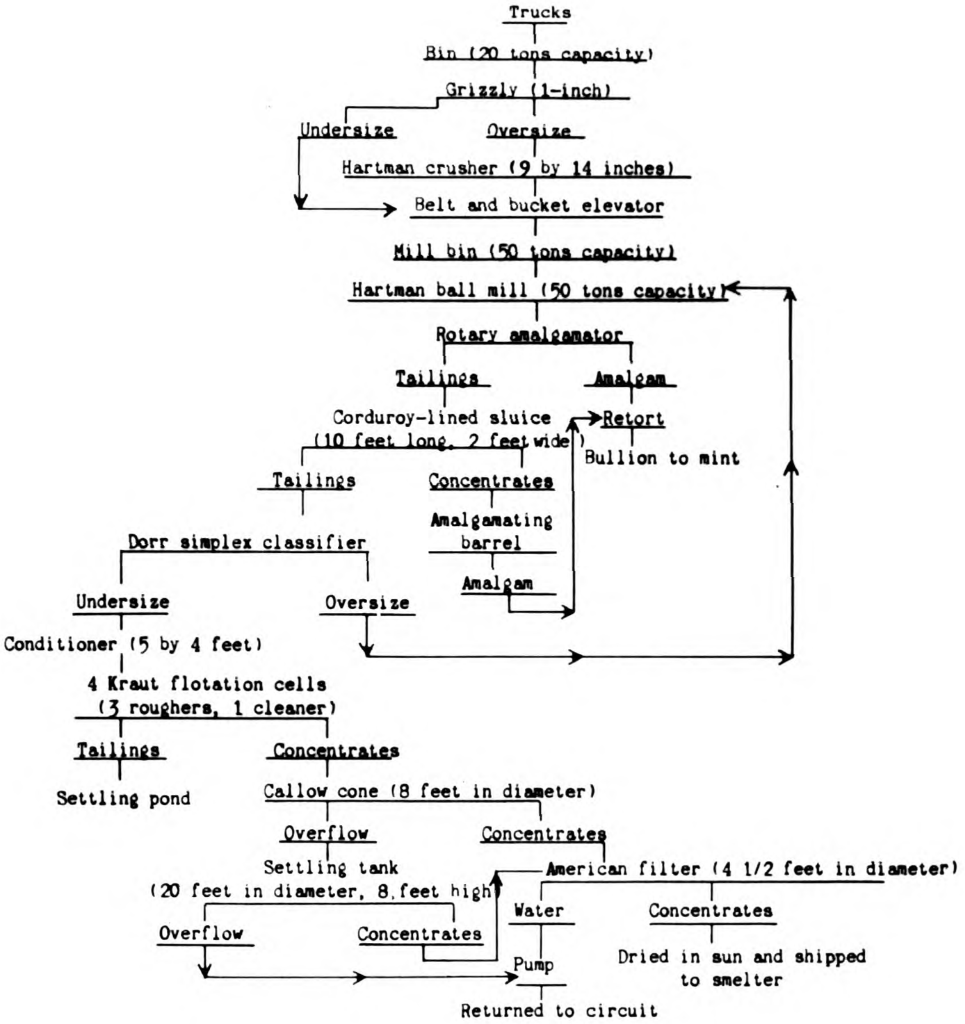

Figure 4.- Flow sheet of the Eldorado Canyon Development Co. mill, Eldorado district, Clark County, Nev.

locomotive. The mine is throoughly ventilated, so that the exhaust gases from the locomotive are not an underground hazard.

The flow sheet of the crushing and screening plant is shown in figure 3. The cars are dumped into a 30-ton storage bin that has a grizzly bottom with 3/4-inch opening for by-passing the fines to the conveyor belt. The oversize passes to a Dodge crusher (24 by 34 inches) set to crush to 4-inch size. From the Dodge crusher the minus 4-inch material passes to a rotary crusher (42 inches) set to crush to 1 1/4-inch size. The minus 1 1/4-inch product and grizzly undersize are conveyed by belt conveyor, to a tramway bin of 100 tons capacity. From the tramway bin the gypsum passes to a measuring pocket regulated by hand, and thence into the aerial tramway cars each holding 1,800 pounds. The tramway is operated by gravity, the loaded cars taking the top cableway track and the empties returning inverted on the lower one. The tramway discharges to a set of stationary scalping screens. The screen products are diverted to loading bunkers and thence to railroad cars.

Power for mining and the crushing plant is furnished by a 180-horsepower Fairbanks-Morse, 3-cylinder, Y-type, Diesel engine.

The direct cost of mining is about $1 per ton, including crushing, screening, and loading, but exclusive of depreciation and depletion.

## Arden Silica Co.

A deposit of silica sand worked by the Arden Silica Co. of Los Angeles, Calif., Harry E. Blood, president, occurs 4.7 miles westerly from Arden, a station on the main line of the Union Pacific R.R. This company has worked the deposit under a lease agreement for the past 4 years, and has produced an average of 7 carloads of molding sand per month. No attempt has been made to utilize the sand for glass making purposes. An average of four men is employed.

The silica occurs as well rounded grains in a cross-bedded sandstone formation at least several hundred feet thick. The sandstone is coherent but it is easily broken down to individual grains by crushing and washing. In places the silica is either stained with iron or cemented with lime.

The sandstone is mined by the room-and-pillar method. Rooms 12 feet wide and 10 feet high are driven into the hill for about 100 feet. Drilling is done with jackhammers and 7/8-inch hollow hexagonal steel. Blasting is done with 40 percent gelatin dynamite, No. 6 detonators, and tape fuse. Compressed air is furnished by a 120-cubic-foot-capacity compressor driven by a 4-cylinder gasoline engine. The sandstone is shoveled into trucks by hand and hauled several hundred feet to the crushing plant.

Crushing-plant equipment consists of a Blake-type jaw crusher (18 by 12 inches), a set of rolls (18 by 30 inches), a belt and bucket elevator, and an Isbell vibrating screen equipped with 14-and 35-mesh screens. The minus

35-mesh screened product is discarded as waste, and the plus 35-minus 14-mesh product is loaded into a truck and hauled 4.7 miles to the washing plant at Arden. Power for the crushing plant is furnished by a 75-horsepower gasoline engine.

Washing-plant equipment consists of a belt and bucket elevator, two screw classifiers, conveyor belt, and storage bin. The classifiers are spiral steel screws, 14 inches in diameter and 12 feet long, that operate in a box launder inclined 19°. Power for the washing plant is furnished by a 75-horsepower gasoline engine.

## COPPER KING (KEY WEST) DISTRICT

### (Copper-Nickel-Platinum, Gold-Silver-Lead, Mica, Beryl, Manganese)

The Copper King district is in the west foothills of the Virgin Range about 15 miles a little west of south from Bunkerville, Nev. It can be reached by automobile by turning south off Highway 91 at Riverside and driving 1.6 miles to the Darling ranch, from which point a winding road goes to the Key West mine, 10.3 miles distant. The former Arrowhead Trail route between Bunkerville and St. Thomas traverses the district, but this road is impassable by automobile.

Copper ore was discovered on the Key West property in the late nineties by Scott Allen, a Cherokee. From 1900 to 1903 the property was explored primarily for copper and nickel by a company called the Nevada Copper and Nickel Co. During the course of this exploratory work, platinum was discovered in the ore by S. W. Darling, who was superintendent of the operations. Although considerable development work was done, very little was produced because of the metallurgical difficulties involved in recovering the metals from the matte.

After the Nevada Copper & Nickel Co. ceased operations, at least three other attempts were made to work the Key West mine, the last being made in 1936 by the International Smelting & Refining Co. of Salt Lake City, Utah.

From other properties in this area small operators and lessees produced (from 1908 to 1932) 1,550 tons of ore that yielded 51.39 ounces of gold, 1,313 ounces of silver, 99,990 pounds of copper, and 26,597 pounds of lead, valued in all at $19,726, an average value of $12.73 per ton.

Mica, beryl, and manganese also occur in this district but virtually none has been produced.

### Key West Mine

The Key West group of seven patented claims is controlled by the R. E. Payne estate of Boston, Mass. The mine lies at an altitude of 3,665 feet. This property is unusually interesting because nickel and platinum are present in the ore, two metals that are comparatively rare in the United States.

The only record of production from the mine is one carload of ore (91,600 pounds) which was shipped to Fredericktown, Mo., about 1903, for testing. According to S. W. Darling, this ore was taken from various places in the mine in order to obtain a representative sample, and the analysis was as follows:

| | | |
|---|---|---|
| Silica | 34.87 | percent |
| Iron | 10.59 | " |
| Lime | 9.41 | " |
| Alumina | 6.55 | " |
| Magnesia | 15.33 | " |
| Copper | 2.30 | " |
| Nickel | 1.79 | " |
| Cobalt | .08 | " |
| Sulphur | 6.90 | " |
| Platinum metals, per ton | .13 | ounce |
| Gold, per ton | Trace | |
| Silver, per ton | Trace | |

The sample contained a small trace of lead, no zinc, and no arsenic; it also contained 0.3 percent titanic oxide.

In 1936 the Key West and other properties in the vicinity were under option to the International Smelting & Refining Co. When the property was visited in November, this company employed a crew of 20 men to rehabilitate the mine. Equipment included a 120-horsepower Caterpillar Diesel engine belt-connected to a 500-cubic-foot-capacity, Sullivan, angle-compound compressor, an 80-horsepower Caterpillar Diesel direct-connected to a single-drum Sullivan hoist, and a 60-horsepower Caterpillar Diesel belt-connected to a Byron-Jackson, 350-gallon-per-minute-capacity, deep-well pump. After the mine was unwatered and a small amount of development work done, the option on the property was relinquished.

According to Bancroft[8], the formation in the vicinity of the Key West mine is gneiss, apparently of granite origin. The gneiss is intruded by basic dikes, which, in turn, have been cut by dikes of aplite and pegmatite. The ore bodies occur as lenticular masses in the most basic of the dikes, which are a variety of peridotite. These peridotite dikes are interesting as they constitute one of the few examples of pre-Cambrian ore deposits in Nevada. The strike of the Key West dike is north 65° east, and the width varies from 8 to 60 feet, averaging about 25 feet. It is cut by numerous faults. To the southwest of the mine the dike is covered by a mantle of detritus, but it can be traced to the northeast, where the topography is rugged for several miles.

In the sulphide zone the ore occurs either as a massive or disseminated sulphide consisting principally of pyrite, chalcopyrite, and pyrrhotite, the latter probably nickeliferous. The platinum appears to be uniformly disseminated through the ore, but the mineral has never been determined.

---

[8] Bancroft, Howland, Platinum in Southeastern Nevada; Contributions to Economic Geology: U. S. Geol. Survey Bull. 430, 1909, pp. 192-199.

## Great Eastern Group

The Great Eastern group of seven unpatented claims lying 1 1/2 miles northeast of the Key West mine is owned by S. W. Darling and A. M. Thompson of Riverside, Nev. This group was located about 35 years ago by the present owners, who did considerable development work by hand methods. In 1936 the property was under option to the International Smelting & Refining Co., but it reverted to the owners about the first of 1937. It has never shipped any ore.

Development work comprises three main adits ranging from 400 to 600 feet in length. Total workings comprise approximately 1,800 feet. There is no equipment on the property.

The peridotite dike has been cut by the three adits, and the geology is similar to that of the Key West mine.

## Other Copper-Nickel-Platinum Claims

The United Nickel group of 13 unpatented claims owned by Robert A. Baker and associates, of Las Vegas, adjoins the Great Eastern group on the northeast. Two unpatented claims owned by Robert A. Baker individually adjoin the Key West group on the south.

In 1936 the International Smelting & Refining Co. is reported to have located a group of 32 claims near the Key West mine.

No real development work has been done on any of the foregoing claims.

## Mica and Beryl Claims

On the western slope of the Virgin Range near the Arizona-Nevada boundary line about 12 miles east of Mesquite, Nev., muscovite mica and beryl occur in pegmatite dikes. The deposits are reached by a poor automobile road, which connects with Highway 91 at the west end of the bridge over the Virgin River near Mesquite. From the bridge the road winds a little east of south for a distance of 9.6 miles. The last 1 1/2 miles must be traversed on foot over a steep trail. Only a small amount of sheet mica has been produced, said to have been shipped some years ago. In recent years there has been no activity.

B. R. McKenna, of Moapa, Nev., and partner own two unpatented claims. On these claims a pegmatite dike has been explored by at least five shallow shafts and open cuts. The dike on which most of the work has been done varies from 1 to 3 feet in width, with a nearly vertical dip. The formation is mica schist. The minerals in the dike are mica, quartz, and feldspar, with occasional crystals of tourmaline and beryl, the latter up to 1 inch in diameter. Insufficient prospecting has been done to determine whether or not beryl occurs in quantities of commercial importance. The mica occurs in books up to several inches thick and from 6 to 8 inches square. The mica seen by the writer contains specks of foreign material and is not cleavable in large sheets.

The Fools Gold group of five unpatented claims recorded in Mohave County, Ariz., is owned by Lloyd Williams, Clarence Stay, and associates, of Las Vegas. According to Stay, crystals of beryl up to 3 inches in diameter have been found on this group of claims in a series of pegmatite dikes up to 12 feet or more in width.

### Manganese Deposit

There is said to be a deposit of manganese in the Virgin Range 18 miles southeast of Mesquite, Nev. The last 4 miles to the deposit must be traversed either on foot or horseback. The deposit is covered by three unpatented claims recorded in Mohave County, Ariz., and owned by Ernest A. Walker and associates of Mesquite. According to Walker, picked samples of manganese ore analyzed 30 to 40 percent manganese, but on the average the grade is considerably less. The deposit has been prospected by a number of shallow open-cuts, but no manganese has ever been produced.

## CRESCENT DISTRICT

(Gold, Silver, Turquoise, Feldspar, Fluorspar, Mica)

The Crescent district is in southern Clark County near the California-Nevada boundary line 6 miles east of Nipton, Calif., a station on the Union Pacific R.R. The Sunset district adjoins it on the north and the Vanderbilt district, in San Bernardino County, Calif., on the south. Prospecting began in this area about 1894, but no important discoveries were made. The period of greatest activity was from 1905 to 1907, when at least 10 incorporated companies were working in this area. During this period the little settlement of Crescent, 6 miles east of Nipton, was established, but it was abandoned soon after. Late in 1936 metal-mining was revived, stimulated by the increased price of precious metals. Most of this work is by small companies or lessees.

The principal production in this area has been derived from the turquoise mines, active from 1894 to 1906. The value of the turquoise produced is not known, but undoubtedly it was considerable. Incomplete statistics of the metal production from 1906 to 1932 give 432 tons of ore containing chiefly gold, with small amounts of silver, lead, and copper, valued at $7,655, or an average of $17.72 per ton. Small amounts of feldspar, fluorspar, and mica also have been produced.

## Nippeno Group

The Nippeno group of five patented claims 2 miles east of Crescent is owned by J. W. Wilson, of Las Vegas, Nev., and Harry Trehearne, of Nipton, Calif. From 1905 to 1907 this property was worked by the Nippeno Mining Co. On February 1, 1937, the property was leased to George Miller and associates. Production from the Nippeno property is said to have been about $40,000, mostly in shipping ore.

Some years ago a mill was built near Crossman's Wells at Crescent to treat the ore. This mill is now owned by Lester A. Scott of Los Angeles. The mill is equipped with a Huntington No. 2 crusher, 5 stamps (each weighing 1,050 pounds), an amalgamation plate, and a small service concentrating table. Power is furnished by a 6-cylinder gasoline engine. Capacity of the mill is about 15 tons per day. Judging from the tailings pile, about 200 tons of ore was treated.

Development work consists of a shaft inclined 50° and 535 feet deep, with levels at 100-foot intervals, and two shafts each about 100 feet deep. Total workings are about 3,000 feet. Mining equipment comprises a 12-horsepower Fairbanks-Morse geared hoist, a Rix compressor (size 6, 8 inches) direct-connected to a gasoline engine, mining tools, blacksmith shop, and camp buildings.

The formation is granite and diorite. The ore occurs in three narrow veins ranging in width from a few inches to 2 feet and averaging about 10 inches. Values are chiefly in gold with small amounts of silver.

## Budget Group

The Budget group of four unpatented claims owned by F. B. McCaughey, of Las Vegas, Nev., and associates is about 1 1/2 miles south of Crescent Peak and 9 miles east of Nipton, Calif. This property was discovered about 1906, at which time a small amount of development work was done, and as nothing of importance was found it was abandoned. It was relocated by the present owners in 1936.

Development work consists of several shallow shafts and several adits, comprising in all about 600 feet in workings. Mining equipment comprises a Ford engine compressor, jackhammer, mining tools, and blacksmith shop. The only production from the property has been 200 tons of ore, averaging about $50 per ton, shipped by the present owners. A shipment made to the American Smelting and Refining Co. from this property on April 21, 1936, furnished the following data:

| | | | | |
|---|---|---|---|---|
| Metal quotations: | Au $34.9125 | | | |
| | Ag .77 | | | |
| | Pb 4.60 less 3.525 | | | |
| | Ounce | | | |
| Settlement assay: | Au 1.3875 | | | |
| | Ag 1.95 | | | |
| | Percent | | | |
| | Pb 3.6 | | | |
| | Cu .1 | | | |
| | Insol. 81.6 | | | |
| | S .5 | | | |
| | Fe 7.8 | | | |
| Value per ton: | Au at 31.81825 | | $44.15 | |
| | Ag 95 percent less 0.5 oz. at 0.77 | | 1.12 | |
| | Pb less 50 percent at 0.215 | | .39 | |
| | Gross value ........................ | | 45.66 | |
| Smelter charge: | Base charge | $3.50 | | |
| | 10 percent excess over $20.00 gr. max. | 2.00 | 5.50 | |
| | Net value per ton .................. | | 40.16 | |
| | Pounds | | | |
| Gross weight | 25,540 | | | |
| Weight, 225 sacks | 255 | | | |
| Wet weight | 25,285 | | | |
| Less 1.7 percent moisture | 429 | | | |
| Dry weight | 24,856 or 12.428 tons at $40.16 | | | $499.11 |
| Deductions: | Freight $4.50 per ton | $57.47 | | |
| | Emergency freight 7 percent.. | 4.02 | | |
| | Switching ................... | 1.35 | | |
| | Emergency freight 10 percent. | .14 | | |
| | Total ................. | 62.98 | | 62.98 |
| | Net proceeds .......... | | | 436.13 |

The ore occurs in a quartz vein striking about north 25 east, dipping 35° to 50°, and ranging from a few inches to 2 feet in width, averaging about 8 inches. The formation is gneiss. Values are chiefly in gold, with small amounts of silver and lead. The quartz is stained with iron and manganese oxides. Wulfenite and a vanadium mineral, probably vanadinite, occur in the vein filling.

## Red Star Group

The Red Star group of five unpatented claims, owned by Harry Trehearne of Nipton, Calif., lies 4 miles north of Crescent. In February 1937 the property was under bond and lease to Ralph Wyman of Glendale, Calif., and his associates. There is no record of any production from the property.

Development work comprises a shaft about 100 feet deep and a crosscut 60 feet long driven from the bottom of the shaft. This work was done in the early days. When the writer visited the property a crew of 3 men was installing equipment in preparation for sinking a new shaft 200 feet. The equipment included a 1-drill Worthington compressor, an air-operated hoist, and mining tools.

The general country rock is gneiss. The so-called "vein" appears to be a mass of quartzite carrying gold and silver values. The deposit is reported to have a width of 25 feet and to average $7 to $8 per ton at current metal prices.

## Lily Group

The Lily (formerly known as the Calavada) group of five unpatented claims owned by Charles Johnson, of Nipton, Calif., is about 5 miles a little south of east from Nipton. The claims lie on the Nevada-California boundary line, and most of the ground lies in San Bernardino County, Calif. When the writer visited the property in February 1937, it was under bond and lease to J. F. McClish of Glendale, Calif. There is no record of any production. Development work consists of one shaft 150 feet deep, 2 shafts each 60 feet deep, several short adits, and scattered surface workings, altogether totaling about 500 feet. In February 1937 the property was idle.

F. L. Ransome[9], who visited the property in 1906, comments as follows:

> About 3 miles southwest of Crescent, on the other side of a gneiss ridge, is the Calavada property. Here, also, the deposit appears to be a much shattered and silicified bed or beds of quartzite resting on the gneiss and dipping gently south at an angle very little steeper than the general slope of the ridge upon which the deposit lies. The quartzite mass is fully 1,000 feet wide from east to west, and the distance from the highest point on the slope to the point where the deposit passes beneath the alluvium of the desert is probably still greater. A shaft 40 feet deep has been sunk at one place without reaching the underlying gneiss.
>
> The material is much shattered and in many places is a breccia of quartz fragments. It is generally rusty and varies in hardness. The deposit has been carefully and conservatively sampled over an area about 1,000 feet square for the purpose of determining its availability for extensive cyanide treatment, the proposition being to handle the material with steam shovels. These assays rarely fall below $2 per ton, and some of them run as high as $12. The average for the whole area is approximately $3 per ton. The deposit is separated from the railway by a mile of gently sloping plain, and water can be pumped from wells sunk in a playa or "dry lake" less than 3 miles away.

---

[9] Ransome, F. L., Preliminary Account of Goldfield, Bullfrog, and other Mining Districts in Southern Nevada: U. S. Geol. Survey Bull. 303, 1907, p. 79-80.

## Double Standard Group

The Double Standard property, comprising two patented claims controlled by the Mitchell Investment Co. of Denver, Colo., is 7 1/2 miles by road northeast of Nipton, Calif. At the time of the writer's visit the property was under lease to W. C. Kelsey, of Searchlight, Nev., who was subleasing it to F. F. Galbraith and partner. Royalty paid by Galbraith is 25 percent on the net returns. In 1905 this property produced several thousand dollars in shipping ore. In 1936 Galbraith and partner mined nearly 200 tons of ore valued at from $25 to $65 per ton.

Development work comprises four shafts, the deepest of which is 100 feet, and several short tunnels, totaling in all about 500 feet. Mining is done by hand methods.

The property lies on a slope of a steep mountain, and the lessees pack the ore 1 mile off the mountain on burros. With a pack team of six burros an average of 3 tons of ore per day can be hauled, each burro carrying two sacks of ore weighing about 110 pounds each. Cost of feeding the burros averages $45 per month. The ore is hauled to Searchlight, a distance of 22 miles, and treated in the Kelsey custom mill. Trucking charge to Searchlight is $3 per ton on contract. Milling charge is $4 per ton, and payment is made for 90 percent of the assay value of the gold figured at $33 per ounce and 90 percent of the assay value of the silver less one ounce at 70 cents per ounce.

The quartz veins dip about 60° and range in width from 2 inches to 3 feet, averaging about 1 1/2 feet. Formation is granodiorite. Values are in gold and silver associated with small amounts of lead and copper.

## Colonel Sellers Claim

The Colonel Sellers property, 3 miles north of Crescent, comprises one patented claim owned by the Mitchell Investment Co. of Denver, Colo. In 1937 it was under lease to Dewey Yeager of Crescent, Nev. Royalty payment is 10 percent of the net mill or smelter returns. This property was first worked about 1905, but there is no record of any production. In the latter part of 1936, Yeager shipped one carload of ore that averaged $20.80 per ton.

Equipment includes a 1-drill giant compressor belt-driven by an automobile engine, jackhammer, and mining tools. Property has been explored by several adits and scattered surface workings, totaling in all about 500 feet.

The ore occurs in narrow quartz veins that dip about 60°. Values are chiefly in gold associated with minor amounts of silver, copper, and lead. Formation is gneiss.

## Cumberland Group

The Cumberland (formerly known as the Oro Fino) group of five unpatented claims owned by Oscar C. Scott of Searchlight, Nev., lies 1 1/2 miles east of Crescent. Production has been about $1,000 in shipping ore. When the writer visited the property it was inactive. Development work consists of a shaft 137 feet deep, inclined 30°, and subsidiary workings, totaling about 350 feet. There is no equipment on the property.

Formation is gneiss and granite. The ore occurs in narrow quartz veins and the values are chiefly in gold associated with silver, lead, and copper. Specimens of ore found on the dump showed vanadinite and wulfenite.

## Turquoise Deposits

Turquoise occurs in two areas in the Crescent district. One deposit, known as the Morgan mine, is 1 1/2 miles south of Crescent, and two other deposits, known as the Smithson-Phillips and the Toltec mines, are on the south slope of Crescent Peak about 3 1/2 miles a little south of east from Crescent. These deposits are of interest in that they were worked in ancient times by Indians, as is evidenced by stone hammers, stone slabs, and other crude tools used to mine and polish the turquoise that were found in the vicinity. In 1894 the Crescent Peak deposits were rediscovered by George Simmons. In 1896 they were acquired by J. R. Wood of New York City, and in the following year operations began under the name of Toltec Gem Mining Co. This company worked the deposits up to 1906 and, judging from the extent of the old workings, a large amount of turquoise was produced. In 1906 a turquoise weighing 320 carats and valued at $2,600 was found in one of the mines.

The Crescent Peak deposits are covered by six patented claims now owned by the county for nonpayment of taxes. In recent years the only activity has been by lessees who confined their activities to screening the dumps. The road to these deposits has been washed out, and the last 1 1/2 miles up the mountain must be traversed on foot.

Mining activity has been confined to two areas about 1 1/2 miles apart. Total workings consisting of a shaft about 240 feet deep, a number of short adits, and open cuts, all of which total about 1,000 feet.

The formation in the vicinity of the turquoise area is a decomposed rock of granitic composition. The rock has been extensively fractured, and in these fractures veinlets of quartz and turquoise have been formed. Some of the fractures are filled with clay gouge in which nodules of turquoise occur coated with kaolin, which has to be chipped off before the quality of the gem can be determined. The color ranges from light to dark blue, texture is dense, and virtually free from matrix. Fragments of turquoise occur in the dumps, and one fragment found by the writer was

1 inch thick and approximately 1 inch square. Most likely most of the material in the dump was rejected because of its light color.

The Morgan mine, covered by one unpatented claim, is owned by Charles Johnson of Nipton, Calif. It was last worked by G. W. Morgan about 1906. Production is said to have been several hundred pounds of fine quality gem turquoise. Development consists of an adit 150 feet long and several open cuts totaling about 200 feet of workings.

Here the turquoise occurs in narrow seams and veinlets in monzonite cut by rhyolite. Fragments of pale-blue to deep-blue turquoise were observed on the dumps. These dumps have been pretty well picked over by Indians.

## Feldspar Deposit

A large deposit of feldspar occurs in a pegmatite dike on the west slope of Crescent Peak 9 miles east of Nipton, Calif., the nearest shipping point. The deposit is said to be owned by Thomas Thorkildson of Los Angeles, Calif.. Shipments of feldspar were made from the property about 1923. Judging from the excavations, probably about 500 tons of feldspar were shipped. In recent years the property has been inactive.

The feldspar was quarried from several open-cuts, the largest of which is about 40 feet long, 18 feet wide, and an average of 15 feet high. As seen in the open-cuts, the pegmatite consists of about 75 percent feldspar, 20 percent quartz, and 5 percent mica. By selective mining the feldspar can be obtained free from the associated minerals.

## Fluorspar Deposits

Small deposits of fluorspar occur in a low range of hills 4 miles due east from Nipton, Calif. Deposits were discovered by Charles Johnson of Nipton in 1914. In 1925 a small amount of development work was done by Thomas Thorkildson of Los Angeles, Calif., but only a few tons of fluorspar have been shipped. The deposits were relocated by Allen Stolte of Searchlight, Nev., in 1934, and presumably he is the present owner. Development work consists of a short tunnel and several open-cuts totaling in all not more than 50 feet. About 6 tons of sorted fluorspar is on the dumps.

The fluorspar occurs in narrow veins ranging in width from several inches up to 15 inches and dipping about 60°. Formation is gneiss. In places the fluorite is stained with copper. The veins so far discovered are too small to produce any appreciable amount of fluorspar.

## Mica Deposit

In 1935 about 5 tons of scrap mica was produced from a pegmatite dike 2 miles southeast of Crescent along the side of the old stage road between Searchlight, Nev., and Ivanpah, Calif. The deposit is owned by H. M. Benson of Crescent, Nev. The only work done on it is an open cut about 10 feet deep and 10 feet wide.

The pegmatite dike is 15 feet wide and consists of an intergrowth of quartz, feldspar, and mica. The mica crystals are small and the material is suitable only for scrap purposes. One-quarter mile north of the pegmatite dike is a prominent outcrop of solid white quartz at least 20 feet wide. The formation is granite.

## ELDORADO (COLORADO) DISTRICT

### (Gold, Silver)

The Eldorado, also known as the Colorado, district comprises an area 12 miles long and 6 miles wide in the north end of the Opal Mountains in southeastern Clark County. It includes the mines in the vicinity of Knob Hill on the west and those in the Capitol area on the east. The camp of Nelson in the central part of the district is 25 miles by road south of Boulder City, Nev. This district is one of the oldest in the State and mining has been done here almost continuously for nearly 80 years. It was organized as the Colorado district in 1861. Old arrastres and prospect holes reported to have been found in this area in the sixties indicate that mining was carried on by Spanish adventurers probably several hundred years ago. The first authentic discovery was in 1857 on the Honest Miner claim, now a part of the Eldorado Rand property. The Techatticup (an Indian word said to signify either "white flower" or "plenty for all") mine was purchased from the original locaters in 1862 by the Southwestern Mining Co. The mine was opened in 1863, and in the following year a 15-stamp chlorination mill was erected at the mouth of Eldorado Canyon on the Colorado River. The salt required for the treatment of ore was mined from the Virgin River salt beds near St. Thomas, Nev., and transported by boat down the Virgin and Colorado Rivers.

The Southwestern Mining Co. dominated the district until about 1897 as it owned virtually all of the productive mines, including the Techatticup, Wall Street, Quaker City, Mocking Bird, Jubilee, Honest Miner, Morning Star, Red Butte, Rover, and others. The company was at first controlled by the Barker brothers and later by Joseph Wharton, a prominent figure in the steel industry of Pennsylvania. During its greatest activity the company owned several mills and operated its own fleet of river boats for bringing in supplies from the Pacific coast. After 1897 the properties were either sold or leased to a number of small companies, which operated with varying success. Speaking of the Eldorado district in 1906, Ransome[10] states:

> It is a little surprising that a district once alive with activity should have attracted so little outside notice. This, however, is partly accounted for by the overshadowing predominance of the Comstock, Eureka, Ely, and other districts noted in

---

[10] Ransome, F. L., Preliminary Account of the Goldfield, Bullfrog, and Other Mining Districts in Southern Nevada: U. S. Geol. Survey Bull. 303, 1907, pp. 63-76.

Digitized by Google Original from THE OHIO STATE UNIVERSITY

the early history of mining in Nevada and by the isolation of Eldorado Canyon. The rich ore shipped from the canyon in early days was taken down the Colorado by boat to Needles, Yuma, or the Gulf of California.

The production of the Eldorado district from 1907 to 1935 is shown in table 2. The bulk of the production, however, was made from 1864 to 1900, and for this period no accurate data are available. Yeoman Briggs, of Nelson, Nev., has compiled production statistics on all the individual properties in this area for the Nelson-Searchlight power district and, according to Briggs, figures the total production has been about $10,000,000. Briggs obtained his data from many sources, and due allowances must be made for old production figures, which have a way of increasing with time.

## Eldorado Canyon Development Co.

The Eldorado Canyon Development Co., D. P. Simons of Nelson, Nev., president, controls the Wall Street group (three patented claims), the Mocking Bird (one patented claim), and seven unpatented claims. The Wall Street mine in the early days is said to have produced $1,750,000, and the Mocking Bird claim $240,000. In 1935 the present company erected a 50-ton daily capacity amalgamation-flotation mill on the property. Since November 1935, when the mill was completed, up to February 1937, 6,500 tons of ore were treated, from which bullion and concentrates valued at $55,000 were produced. Most of the ore was obtained from the dumps and stope fills. An average of 12 men are employed.

Development work comprises a number of shafts, the deepest of which is about 200 feet, and approximately 1 mile of underground workings. Most of the development work has been done on the Wall Street group of claims.

The Wall Street vein strikes about east and west, with a dip of 15° to 30° to the south. The old stopes mined through to the surface show widths up to 15 feet. The ore occurs in a shattered zone of monzonite in a gangue of quartz, calcite, and country rock. Values are in gold and silver.

The flow sheet of the mill is shown in figure 4. The only unusual feature of the flow sheet is the rotary amalgamator employed. The amalgamator is an iron cylinder (3 feet long and 15 inches in diameter), inside of which is an amalgamating plate sleeve and an 8-mesh screen. The cylinder is connected to the discharge end of the ball mill. A water spray is used to prevent the screen from blinding. Mercury is added to the ball mill and the amalgamator is cleaned up about every 10 days. An average of 55 percent of the values is recovered by amalgamation. The over-all recovery is about 86 percent. The ore is ground to minus 60 mesh, and a pulp density of 24 percent is maintained in the flotation circuit. Flotation reagents are Z-6, copper sulphate, soda ash, and pine oil. The concentration ratio is 250 to 1, and the flotation concentrates have an average value of $900 per ton. The cost of milling is $2.55 per ton, including the trucking cost. Power is furnished by a 110-horsepower, Pacific, 3-cylinder, Diesel engine connected

TABLE 2. - Gold, silver, copper, lead, and zinc production from Eldorado Canyon District, Clark County, Nevada, 1907-1935

(Compiled by Charles White Merrill, supervising engineer,
San Francisco office, Mineral Production and Economics Division, U. S. Bureau of Mines)

| Year | Placer | | | | | | Lode | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of mines | Gold | | Silver | | Total value | No. of mines | Ore, short tons | Gold | |
| | | Fine ounces | Value | Fine ounces | Value | | | | Fine ounces | Value |
| 1907 | — | — | — | — | — | — | 5 | 417 | 306.94 | $ 6,345 |
| 1908 | — | — | — | — | — | — | 1 | 25 | 36.28 | 750 |
| 1909 | — | — | — | — | — | — | 3 | 48 | 74.01 | 1,530 |
| 1910 | — | — | — | — | — | — | 1 | 431 | 139.08 | 2,875 |
| 1911 | — | — | — | — | — | — | 6 | 541 | 125.53 | 2,595 |
| 1912 | — | — | — | — | — | — | 5 | 137 | 37.20 | 769 |
| 1913 | — | — | — | — | — | — | 4 | 276 | 125.29 | 2,590 |
| 1914 | — | — | — | — | — | — | 2 | 162 | 81.56 | 1,686 |
| 1915 | — | — | — | — | — | — | 3 | 6,547 | 3,047.58 | 62,999 |
| 1916 | — | — | — | — | — | — | 9 | 24,868 | 10,310.26 | 213,132 |
| 1917 | — | — | — | — | — | — | 7 | 12,689 | 6,631.18 | 137,079 |
| 1918 | — | — | — | — | — | — | 4 | 15,302 | 5,424.92 | 112,143 |
| 1919 | — | — | — | — | — | — | 4 | 13,875 | 3,553.63 | 73,460 |
| 1920 | — | — | — | — | — | — | 3 | 9,160 | 2,280.01 | 47,132 |
| 1921 | — | — | — | — | — | — | 1 | 2 | 1.06 | 22 |
| 1922 | — | — | — | — | — | — | — | — | — | — |
| 1923 | — | — | — | — | — | — | 1 | 160 | 80.83 | 1,671 |
| 1924 | — | — | — | — | — | — | 1 | 917 | 1,001.46 | 20,702 |
| 1925 | — | — | — | — | — | — | 5 | 708 | 539.14 | 11,145 |
| 1926 | — | — | — | — | — | — | 4 | 2,104 | 1,380.57 | 28,539 |
| 1927 | — | — | — | — | — | — | 3 | 1,155 | 945.05 | 19,536 |
| 1928 | — | — | — | — | — | — | 3 | 1,183 | 468.56 | 9,686 |
| 1929 | — | — | — | — | — | — | 3 | 2,207 | 1,434.46 | 29,653 |
| 1930 | — | — | — | — | — | — | 2 | 3,350 | 1,277.05 | 26,399 |
| 1931 | — | — | — | — | — | — | 1 | 3,689 | 2,174.55 | 44,952 |
| 1932 | 2 | 110.68 | $2,288 | 27 | $ 8 | $2,296 | 8 | 3,463 | 968.34 | 20,017 |
| 1933 | 3 | 40.32 | 1,031 | 11 | 4 | 1,035 | 7 | 1,823 | 663.20 | 16,951 |
| 1934 | 1 | 3.19 | 111 | — | — | 111 | 3 | 4,086 | 927.55 | 32,418 |
| 1935 | 3 | 11.41 | 399 | 1 | 1 | 400 | 11 | 3,565 | 856.89 | 29,991 |
| Total | — | 165.60 | 3,829 | 39 | 13 | 3,842 | — | 112,890 | 44,892.18 | 956,767 |

TABLE 2. - Gold, silver, copper, lead, and zinc production from Eldorado Canyon District, Clark County, Nevada, 1907-1935 (Continued)

(Compiled by Charles White Merrill, supervising engineer, San Francisco office, Mineral Production and Economics Division, U. S. Bureau of Mines)

| Year | Lode | | | | | | | | | Average recoverable value of ore per ton[1] | Total value (lode & placer) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Silver | | Copper | | Lead | | Zinc | | Total value | | |
| | Fine ounces | Value | Pounds | Value | Pounds | Value | Pounds | Value | | | |
| 1907 | 4,533 | $ 2,992 | — | — | — | — | — | — | $ 9,337 | $22.39 | $ 9,337 |
| 1908 | — | — | — | — | — | — | — | — | 750 | 30.00 | 750 |
| 1909 | 3,212 | 1,670 | — | — | 2,232 | $ 96 | — | — | 3,296 | 68.67 | 3,296 |
| 1910 | 2,335 | 1,261 | — | — | — | — | — | — | 4,136 | 9.60 | 4,136 |
| 1911 | 3,799 | 2,013 | — | — | 32 | 1 | — | — | 4,609 | 8.52 | 4,609 |
| 1912 | 10,379 | 6,383 | 157 | $ 26 | 442 | 20 | — | — | 7,198 | 52.54 | 7,198 |
| 1913 | 346 | 209 | 297 | 46 | — | — | — | — | 2,845 | 10.31 | 2,845 |
| 1914 | 1,650 | 912 | — | — | 292 | 11 | — | — | 2,609 | 16.10 | 2,609 |
| 1915 | 56,859 | 28,828 | — | — | 180 | 8 | — | — | 91,835 | 14.03 | 91,835 |
| 1916 | 241,789 | 159,097 | 1,205 | 296 | 11,771 | 812 | — | — | 373,337 | 15.01 | 373,337 |
| 1917 | 90,618 | 74,669 | 281 | 77 | 4,956 | 426 | — | — | 212,251 | 16.73 | 212,251 |
| 1918 | 103,672 | 103,672 | 119 | 29 | 3,450 | 244 | — | — | 216,088 | 14.12 | 216,088 |
| 1919 | 113,039 | 126,604 | — | — | — | — | — | — | 200,064 | 14.42 | 200,064 |
| 1920 | 85,113 | 92,773 | — | — | 148 | 12 | — | — | 139,917 | 15.27 | 139,917 |
| 1921 | 22 | 22 | — | — | — | — | — | — | 44 | 22.00 | 44 |
| 1922 | — | — | — | — | — | — | — | — | — | — | — |
| 1923 | 2,283 | 1,872 | — | — | — | — | — | — | 3,543 | 22.14 | 3,543 |
| 1924 | 2,265 | 1,518 | 1,189 | 156 | 7,870 | 630 | — | — | 23,006 | 25.09 | 23,006 |
| 1925 | 3,621 | 2,513 | 736 | 105 | 6,674 | 581 | — | — | 14,344 | 20.26 | 14,344 |
| 1926 | 17,714 | 11,054 | 2,816 | 394 | 18,808 | 1,505 | 1,800 | $ 135 | 41,627 | 19.78 | 41,627 |
| 1927 | 2,912 | 1,651 | 927 | 121 | 4,435 | 279 | — | — | 21,587 | 18.69 | 21,587 |
| 1928 | 1,000 | 585 | 568 | 82 | 2,242 | 130 | — | — | 10,483 | 8.86 | 10,483 |
| 1929 | 9,813 | 5,230 | 264 | 46 | 3,860 | 243 | — | — | 35,172 | 15.94 | 35,172 |
| 1930 | 5,507 | 2,120 | 432 | 56 | 1,537 | 77 | — | — | 28,652 | 8.55 | 28,652 |
| 1931 | 6,436 | 1,866 | — | — | — | — | — | — | 46,818 | 12.59 | 46,818 |
| 1932 | 3,690 | 1,041 | — | — | 499 | 15 | — | — | 21,073 | 6.09 | 23,369 |
| 1933 | 2,796 | 979 | 250 | 16 | 5,664 | 210 | — | — | 13,156 | 9.96 | 19,191 |
| 1934 | 6,731 | 4,348 | 1,813 | 145 | 9,911 | 367 | — | — | 37,278 | 9.12 | 37,389 |
| 1935 | 7,359 | 5,289 | 443 | 37 | 2,271 | 91 | — | — | 35,408 | 9.93 | 35,808 |
| Total | 789,493 | 641,171 | 11,497 | 1,632 | 87,254 | 5,758 | 1,800 | 135 | 1,605,463 | 14.22 | 1,609,305 |

[1] Not to be confused with average assay value.

to a 75-kva generator. The cost of power is 1 1/2 cents per kilowatt hour. Water for milling is pumped from a shaft in the vicinity.

## Diamond Gold Mining Co.

The Diamond Gold Mining Co., P. A. Simon, Las Vegas, Nev., president and general manager, controls 12 patented mining claims and 1 patented millsite, the latter at the mouth of the Eldorado Canyon on the Colorado River, 6 miles east of the mine. The property is worked under bond and lease from the Joseph Wharton estate, administered by the Girard Trust Co. of Philadelphia, Pa. It includes the Techatticup mine, which has been the largest producer in the Eldorado district.

Production of the Techatticup mine, most of which was made prior to 1900, is estimated at about $3,500,000. Judging from the extent of the mine workings, the tailings pile (about 150,000 tons) near the present millsite, and the ore that was treated in the early days in mills on the Colorado River, this estimate is probably fairly accurate. From 1913 to 1920 the mine was operated by Martin Heller of New York City. According to P. A. Simon, production for this period was 60,000 tons of ore averaging 0.55 oz. gold and 9.5 oz. silver, having a value of $17.82 per ton. This ore was treated in the cyanide mill formerly on the property. From 1923 to 1930 the Stile brothers, lessees, produced $48,000 in crude ore and flotation concentrates. Under the management of P. A. Simon, the mine has been operated intermittently for the past four years. In February 1937 the Diamond Gold Mining Co. employed an average of 35 men.

Development work comprises about 3 miles of underground workings. The Techatticup inclined shaft has a depth of 600 feet, with levels at about 100-foot intervals. An adit 180 feet long connects with the Techatticup shaft about 200 feet below the outcrop of the vein. An interesting feature of the property is that most of the development work has been in ore.

Mining equipment includes three compressors - an Ingersoll-Rand (12 by 12 inches), a Union (10 by 12 inches), and an Ingersoll-Rand Imperial type 10 (10 by 16 by 12 inches) drill sharpener, rock drills and other mining tools. Hoisting is done in a 1-ton skip operated by 20-horsepower Fairbanks-Morse geared hoist. There is a 50-ton daily capacity amalgamation-flotation mill on the property. Power for mining and milling is furnished by a 200-horsepower, Fairbanks-Morse, Y-type, Diesel engine.

There are two veins on the property - the Savage and the Techatticup. In the former silver values predominate, while in the latter values are chiefly in gold. The ore occurs as a network of stringers in monzonite. The strike of the veins is about east and west, and the dip varies from 20° to 70° to the north. The width varies from 2 to 12 feet, averaging about 5 feet. The Techatticup vein is traceable on the surface for several thousand feet. The gangue minerals are principally quartz, calcite, and shattered country rock, with subordinate amounts of pyrite, sphalerite, galena, and chalcopyrite. A little below the 400-foot level the veins are displaced by a flat fault. The monzonite stands well, and the open stope method of mining is employed.

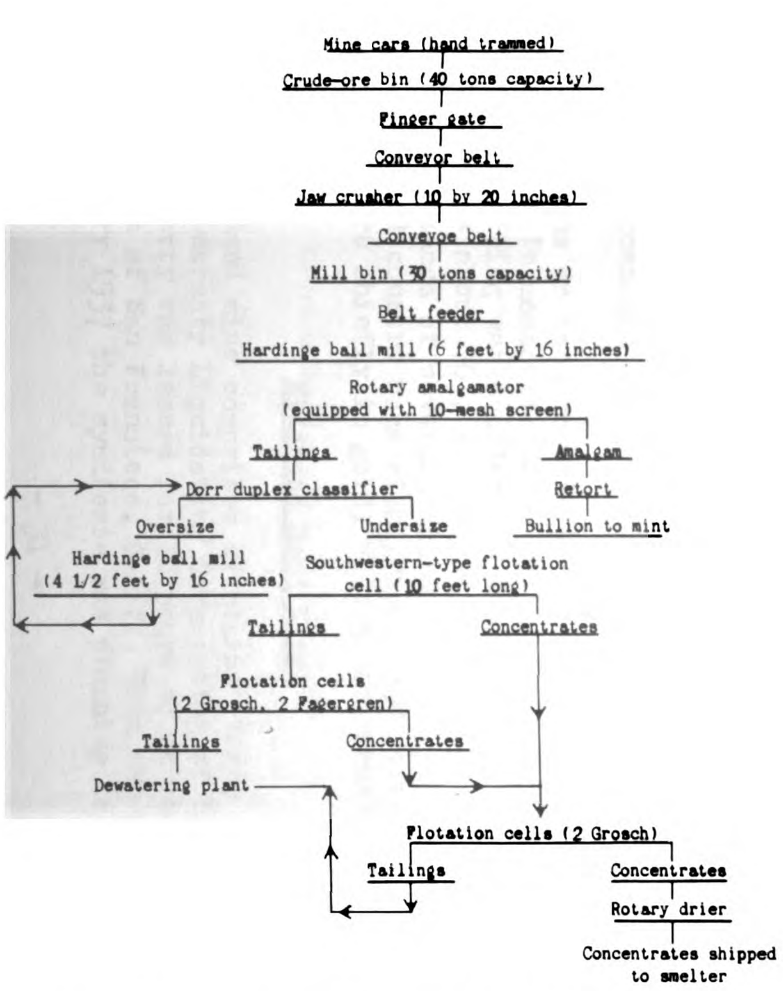

Figure 5.- Flow sheet of the Diamond Gold Mining Co. mill, Eldorado district, Clark County, Nev.

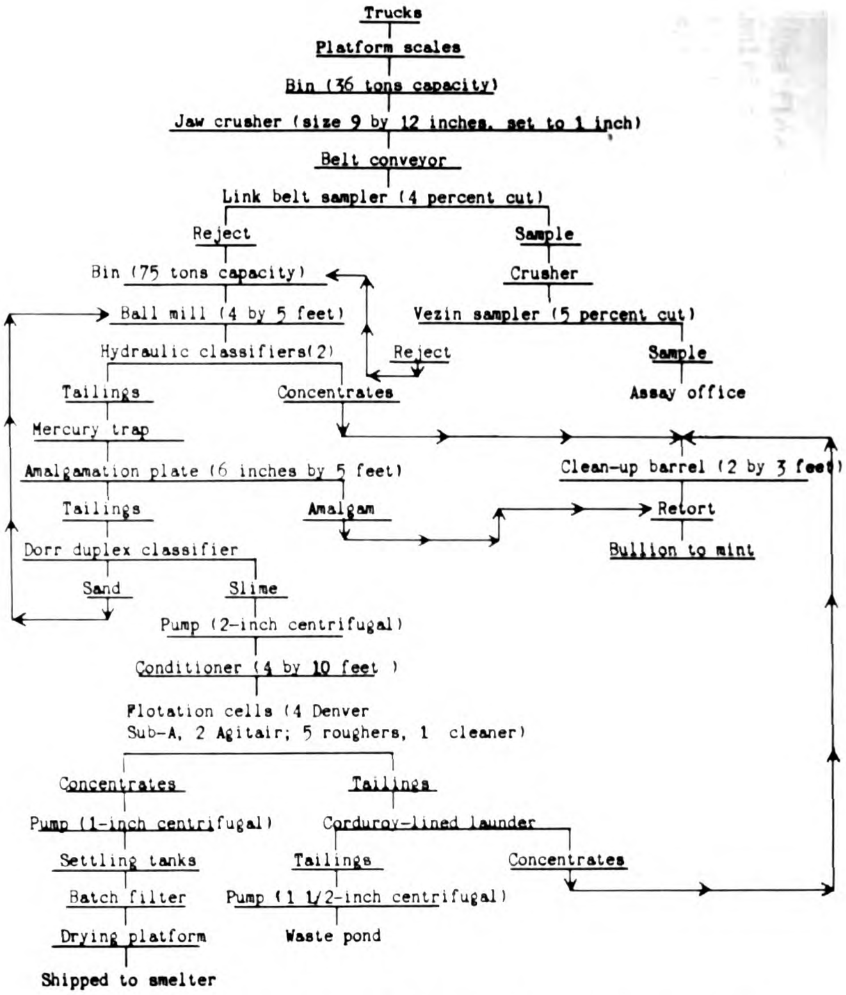

Figure 6.- Flow sheet of Kinney custom mill, Goodsprings, Clark County, Nev.

The flow sheet of the mill is shown in figure 5. Water for milling is hauled from the Colorado River, 6 miles distant, in tanks mounted on trucks, at a cost of $2 per 1,000 gallons. In February 1937, to eliminate the water haul, the company was installing a 4-inch pipe line 5.7 miles long from the Colorado River to the mill. The total lift will be 1,842 feet, and water will be pumped to the mine in two stages by triplex pumps. The value of the ore treated is from $12 to $18 per ton, averaging about $15. Recovery by amalgamation and flotation averages 85 percent. Flotation concentrates have a value of from $500 to $1,400 per ton.

## Eldorado Rover Mining Co.

The Eldorado Rover Mining Co., P. A. Keegel, of Las Vegas, Nev., president and general manager, controls the Rover, Flagstaff (Duncan), Rambler, and Sky Lark groups, comprising 17 patented claims. Production from these groups of claims has been about $550,000 of which $360,000 was produced from the Flagstaff. In February 1937, 12 men were employed and the company was preparing to operate its 75-ton daily capacity cyanide mill.

Development comprises three inclined shafts, the deepest of which is the Flagstaff, which is inclined 40° and is 500 feet deep. Underground workings total about 4 miles. Mining equipment includes a 25-horsepower Fairbanks-Morse geared hoist at the Duncan shaft, a 15-horsepower Fairbanks-Morse geared hoist, and an Ingersoll-Rand Imperial type 10, 2-stage compressor belt driven by a 60-horsepower Fairbanks-Morse distillate engine at the Rambler shaft. The mill is equipped with a Blake type crusher (10 by 16 inches), belt driven by a 25-horsepower Fairbanks-Morse distillate engine; 10 stamps (1,250 pounds each); a pebble mill (16 feet long and 4 1/2 feet in diameter); a Dorr duplex classifier, Wilfley table, two agitators (18 feet by 12 feet), a thickener (24 by 12 feet), and Oliver filter (9 feet in diameter), solution tanks, and other cyaniding equipment. Power is furnished by a 90-horsepower, Fairbanks-Morse, Y-type, 3-cylinder, Diesel engine and a 40-horsepower, Fairbanks-Morse, distillate engine. Water for milling is pumped from the Duncan and Rambler shafts.

The three veins on the property are the Rambler, Rover, and Flagstaff, which occur either in monzonite or at the contact of monzonite and andesite. In February 1937 mining was confined to the Rover vein. This vein strikes east and west, dips about 70°, and ranges in width from 2 to 6 feet. It outcrops for a distance of several thousand feet. The ore occurs in a gangue of shattered country rock with bunches and stringers of quartz and calcite. Values are chiefly in gold, with minor amounts of silver.

## Eldorado Rand Mine

The Eldorado Rand mine comprises 27 claims (three of them patented) controlled by the Guaranty Liquidating Corporation of Los Angeles, Calif. Recently this property was leased for 10 years to an eastern syndicate represented by John Daam of San Francisco, Calif. When the writer visited the property in February 1937 the syndicate was planning to develop the mine further and to construct a mill on the Colorado River, about 8 miles east. This property has been a consistent producer, and past production, chiefly from the Quaker City and Rand patented claims, has been approximately $1,000,000.

Development comprises about 6,000 feet of underground workings. The Rand shaft is 350 feet deep. Equipment includes a 40-horsepower Fairbanks-Morse geared hoist, a compressor (10 by 10 inches) belt driven by a Fairbanks-Morse distillate engine, and a 10-stamp cyanide mill originally built in 1907. The mill equipment is in poor condition. Adjacent to the mill is a tailings pile estimated to contain 50,000 tons, but the writer could not learn whether the tailings contained sufficient values to be worth retreating.

The ore occurs in a series of veins varying from 3 to 6 feet in width in a monzonite formation. The veins are distinguished by their diversity in dip, varying from nearly horizontal to 80°. Values, chiefly gold and silver, occur in fissure zones in a gangue of country rock, calcite, quartz, pyrite, galena, and sphalerite.

### Crown Queen Group

The Crown Queen group of three patented claims, known as the Eldorado Crown Mining Co., is controlled by Martin Heller, 120 Broadway, New York City. In February 1937 the property was worked by R. T. Roe, W. R. Cozart, and Osborne Gentry under 1-year lease with a royalty of 10 percent of net mill or smelter returns. The lessees were working at the surface on the east end of the vein, and several hundred tons of ore, said to average $15 per ton, had been exposed. Arrangements were being made to treat the ore at the Eldorado Rover mill, 2 miles distant. Prior to 1907 the property is said to have produced $450,000 in milling ore treated at the Techatticup mill.

Development work comprises a shaft 300 feet deep and inclined 52° and more than a mile of underground workings. Equipment includes a Rix 1-drill compressor belt driven by 6-cylinder automobile engine.

The main vein strikes east and west and dips 50° to the south. Formation is monzonite and andesite. Judging from the old stopes mined through to the surface, the average width of the vein is about 5 feet. Gold and silver values occur in a network of small stringers in a fairly well defined zone in shattered country rock.

### Eldorado Empire Mining Co.

The Eldorado Empire Mining Co., C. E. L. Gresh, of Nelson, Nev., president and principal owner, controls the Empire group of three claims (one patented) adjoining the Wall Street group on the east. Although operations have been carried on intermittently for a number of years, very little has been produced and in February 1937 it was inactive.

Development work comprises a shaft 200 feet deep and other workings totaling in all about 2,000 feet. Mining equipment includes a 6-horsepower Fairbanks-Morse geared hoist, a 1-drill Ingersoll-Rand compressor, assay office, and blacksmith shop.

Equipment for a partly completed mill consists of a small Wheeling crusher, a Marathon rod mill, and a 15-horsepower Fairbanks-Morse distillate engine.

According to Gresh, the ore occurs in a brecciated zone 40 feet wide, in monzonite. When the writer visited the property, about 50 tons of ore on the dumps were reported to average about $12 per ton in gold and silver. It was planned to treat this ore in the nearby Eldorado Canyon Development Co. mill.

## Golden Empire Group

The Golden Empire group of eight claims owned by John S. Sartain is in the western part of the Eldorado district in the vicinity of Knob Hill. This property has been worked intermittently for many years and production is reported to have been about $50,000 in shipping ore. In February 1937 the property was under lease to R. W. Cate, with royalty payment of 10 percent on the net smelter returns. In 1936 Cate shipped 50 tons of ore averaging $50 per ton. The ore is mined by hand methods. The haul to Boulder City, 32 miles from the property, costs $3 per ton. Development work comprises four shafts, each about 100 feet deep, and subsidiary workings, totaling in all about 1,000 feet.

The ore occurs in narrow veins from a few inches to 2 1/2 feet wide, striking east and west and dipping 60° to 80° to the south. Values are in gold and silver. Formation is gneiss and schist.

## Other Properties

The Rich Hill group of two claims owned by J. Taylor, the Silver Legion group of nine claims owned by John S. Sartain and associates, and the Combination group of two claims are in the Knob Hill section of the Eldorado district. When the writer visited here in February 1937 these properties were inactive.

In general, the ore in the Knob Hill area is in east and west quartz veins in gneiss and schist. Some of the veins, although narrow, are very persistent and can be traced for several thousand feet. The values are in gold and silver associated with small amounts of pyrite, galena, and sphalerite.

In the Capitol area, in the eastern part of the district, a number of small properties were operated in former years. The first discovery in this area was made in 1894 by John Appel. The principal property is the Capitol group of five patented claims owned by Thomas F. Murphy of Los Angeles, Calif. Production is reported as $100,000.

Other properties are the Briggs Capitol group of 17 patented claims owned by Yeoman Briggs of Nelson, Nev., the Wallace group of 10 patented claims owned by William C. Wallace of Oakland, Calif., and associates, the Nevada Eagle group of six patented claims owned by the J. T. Weyerhaeuser interests of Tacoma, Wash., and various other groups of unpatented claims.

In the Capitol area the ore occurs as numerous narrow quartz veins in monzonite and andesite. Values are chiefly in gold, with small amounts of silver. Nearly all the properties in this section are in the prospect stage of development.

## GOLD BUTTE DISTRICT

(Gold, Zinc, Copper, Mica, Magnesite)

The Gold Butte district is in southeastern Clark County in the southern end of the Virgin Range. It includes the territory south of Gold Butte lying between the Nevada-Arizona boundary line on the east and the Virgin River on the west. Mining was begun in this area in the eighties. A small boom occurred in 1908, when the camp of Gold Butte was established, and although a number of small companies were organized to work various properties, no important discoveries were made. The total production from the district has been about $75,000, mostly in shipping ores. In 1936 the principal operation in the district was that of the Lake Shore Mining Co.

The geology of the Gold Butte mining district has been described by Hill[11].

The ore deposits are of two types - replacement deposits in limestone and quartz veins in gneiss and granite. The ore in the limestone consists of oxidized copper, lead, and zinc minerals. The values in the quartz veins are chiefly in gold.

A small amount of sheet mica has been produced from pegmatite dikes in the vicinity of Gold Butte.

### Lake Shore Mining Co.

The property of the Lake Shore Mining Co., comprising the Utah group of four unpatented claims owned by O. W. Yates, A. W. Lawson, and Fred Gibson of Las Vegas, Nev., is located about 15 miles south of Gold Butte and 5 miles from the shore of Lake Mead. In 1934 and up to July 1935 the Utah group and other claims were worked by the Gold Cross Mining Co., controlled by Salt Lake City interests. The Gold Cross Mining Co. erected a small amalgamating mill on the shore of the Colorado River and treated about 400 tons of ore. This company also shipped 340 tons of ore, averaging $51 per ton, to Utah smelters. The Lake Shore Mining Co. acquired the Utah group of claims under bond and lease from C. C. McDonald, of Overton, Nev., in 1935 and started operations in September of the same year. Up to February 1937 total production by the present owners was 1,800 tons of shipping ore with a net value of $30,000. Five men are employed. Development work comprises an incline 200 feet deep and other workings, totaling about 400 feet.

---

[11] Hill, James M., Notes on Some Mining Districts in Eastern Nevada: U. S. Geol. Survey Bull. 648, 1916, pp. 42-53.

The ore occurs in a quartz vein that dips about 8° and follows the hanging-wall side of a diabase dike. The width of the vein varies from 6 inches to 6 feet, averaging about 2 feet. The vein and dike are in granite formation.

Due to the flat dip of the vein, most of the ore shipped by the present owners is mined by the open-cut method. The granite overburden is drilled with jackhammers and blasted with 40 percent gelatin dynamite and No. 6 caps attached to tape fuse. Compressed air is furnished by a portable compressor. Stripping is done with a 10-cubic-foot capacity Le Tourneau bulldozer operated by a 60-horsepower caterpillar tractor. The average cost of stripping is 12 cents per cubic yard. After the overburden has been removed (a maximum depth of 20 feet), the ore is hand shoveled into a truck and hauled 5 miles to the shore of Lake Mead, where it is loaded onto a barge. The barge is towed by power boat 56 miles to Cashman Docks, and the ore is again shoveled into trucks and hauled to the railroad siding at Boulder City, 6 1/2 miles distant. The barge and power boat are owned by the company. Smelter returns from a shipment of ore to the American Smelting & Refining Co. were as follows:

| | | |
|---|---|---|
| Metal quotations: | Au | $34.9125 per oz. |
| | | Oz. |
| Settlement assay: | Au | 1.5525 |
| | Ag | .775 |
| | | Percent |
| | Insol | 88.7 |
| | S | .4 |
| | As | .1 |
| | Fe | 4.3 |
| | CaO | 1.5 |

| | | |
|---|---|---|
| Metal payment: Au at $31.81825 per oz. | | $49.40 |
| Treatment charge (base) | $ 3.22 | |
| 10 percent excess over $20 (max.) | 1.78 | |
| Total treatment charge | 5.00 | 5.00 |
| Net value per ton | | 44.40 |
| | Lb. | |
| Wet weight | 125,740 | |
| Less 2.15 percent moisture | 2,704 | |
| Net weight | 123,036 or 61.518 tons. | |
| 61.518 tons at $44.40 per ton | | $2,731.40 |
| Freight, $6.60 per ton | $414.94 | |
| Emergency freight | 25.15 | |
| Demurrage | 2.00 | |
| Watching | 8.00 | |
| Assaying | 6.00 | 456.09 |
| Net proceeds | | 2,275.31 |

## Azure Ridge Group

The Azure Ridge group of four unpatented lode claims owned by John F. Perkins of Overton, Nev., is near the Arizona-Nevada boundary in the southeastern part of the Gold Butte district. The only production from the property was in 1918, when John F. Perkins shipped two carloads of zinc ore and one carload of copper ore. The zinc ore averaged 40 percent zinc and the copper ore 35 percent copper, with small values in gold and silver. This ore was hand-sorted and hauled to St. Thomas for shipment to smelters. Since 1918 the property has been inactive.

This property is in the prospect stage of development and all work has been superficial in character. Development comprises an adit 100 feet long, another of 40 feet, and several shallow shafts, totaling in all about 300 feet of workings. Mineralization occurs in a faulted zone in limestone near granite.

## Webster Group

A group of seven unpatented claims in Cedar Basin is owned by Mrs. A. G. Webster of Moapa, Nev. In 1937 this property was under option to H. G. Snyder of Salt Lake City, Utah. Development comprises a shaft 130 feet deep and several hundred feet of lateral workings. Property is equipped with a 2-stamp mill (1,050 pounds each), a jaw crusher (6 by 8 inches), and an amalgamation plate (4 feet long and 3 feet wide). Mill equipment is operated by an automobile engine. About 150 tons of ore, averaging 1 ounce of gold per ton, was treated in this mill.

The ore occurs in a quartz vein in the granite. The dip of the vein is about 75° and the average width is 18 inches. Formation is altered granite and schist traversed by pegmatite dikes.

## Mica Deposits

In 1873 Daniel Bonelli discovered mica deposits 4 miles east of Gold Butte, but because of their isolation and unfavorable transportation facilities very little mining was done. As far as the writer could learn, the only production has been 5 tons of sheet mica shipped by Bonelli prior to 1900 and 2,500 pounds shipped by Frank Allsop in 1908. In recent years these deposits have not been exploited. William Garrett of Gold Butte is the owner of several unpatented mica claims in this area.

The deposits have been prospected by a number of shallow shafts, the deepest of which is about 40 feet. The mica, associated with garnet, quartz, feldspar, and tourmaline, occurs in pegmatite dikes that cut granitic schists. Due to the manner in which the mica occurs, it is difficult to mine it in large sheets. The mica is said to be of good quality as to transparency, color, cleavage, and flexibility, and the size of the sheets varies from 6 to 15 square inches.

## Magnesite Deposit

Magnesite occurs in the vicinity of Horse Springs, 14 miles by road southeast of St. Thomas, Nev., and 9 miles north of Gold Butte. The deposit was located originally by Fay Perkins of Overton, Nev., in 1922. The present owner is Albert Bauer. No production has ever been made. Development comprises several short tunnels and a shaft about 60 feet deep. Fine-grained dolomite and magnesite beds overlain by shale and underlain by limestone and dipping about 30° outcrop for several thousand feet.

## GOODSPRINGS (YELLOW PINE) DISTRICT

### (Zinc, Lead, Copper, Gold, Silver, Molybdenum, Vanadium, Cobalt, Platinum)

The Goodsprings, also known as the Yellow Pine, district covers an area of several hundred square miles in the southern part of the Spring Mountain Range in southwestern Clark County. The town of Goodsprings, the center of mining activities of this area, is 8 miles northwest of Jean, Nev., a station on the Union Pacific R.R.

Potosi mine in the northern part of the district was discovered by a party of Mormons in 1855. Shortly after, a small amount of lead ore was mined from this property and was treated locally in crude smelters in order to obtain lead for bullets. This venture proved unsuccessful and work stopped until 1868, when a group of prospectors found lead ore in the southern part of the area. They located a number of claims and organized the New England mining district, but when they found that the lead carried low silver values the district was abandoned. A member of this party, named Good, camped at the springs in the vicinity after the others had left, and Goodsprings was named for him. After the collapse of the New England district, the only work done for many years was by prospectors from Ivanpah, Calif., and Eldorado, Nev.

The permanent settlement of Goodsprings dates from 1886, when A. G. Campbell, John Denslow, A. E. Thomas, William Smith (all from Utah), and others began a systematic search for lead ore. They located over 40 claims and did considerable development work. In 1892 a miner by the name of Jonas Taylor, from Ivanpah, Calif., located a cropping of iron oxides and named it the Keystone mine. Samuel Godby of Pioche, Nev., secured from Taylor a short-time option on one-half interest in the Keystone mine for $20,000. Godby hastened to San Francisco, where he sold one-half of the option to a banker for $20,000, thereby securing a one-quarter interest for virtually nothing. The three partners started to work the property and several carloads of ore were shipped to Colorado smelters, one netting them $9,000 and another nearly $16,000. At that time the nearest railroad connection was at Fenner, Calif., on the main line of the Santa Fe, approximately 100 miles to the south. The high-grade ore shipped from the Keystone caused considerable excitement, and at the end of 1892 the camp had a population of 200. In December 1893 a 10-stamp mill was erected to treat Keystone ore at a place in Mesquite Valley then known as Taylors Well but now known as Sandy. The Keystone mine was worked with varying success until 1906, production being about $600,000.

In 1893 a branch railroad was built from the Santa Fe line to a point 45 miles from Goodsprings, and the northern terminus, Manville, became the shipping point. This branch was extended 16 miles nearer Goodsprings in 1901. When the San Pedro, Los Angeles, & Salt Lake R.R. (now part of the Union Pacific System) was completed in the spring of 1905, Jean, 8 miles from Goodsprings, became the shipping point. Prior to the completion of this railroad some shipments of lead and copper ore were made over the Santa Fe branch, but the long wagon haul was too expensive for any but the highest-grade ores.

In 1905 the mineral reserves were increased vastly by the recognition of zinc in the ores by C. T. Brown, a mining engineer from Socorro, N. Mex. Prior to Brown's discovery, the earthy material associated with the lead ore (that proved to be hydrozincite) was thrown over the dumps. Following the discovery of zinc in the lead ore, a number of deposits were discovered and shipments of crude ore were made from the Potosi, Hoosier, and other mines in 1905.

In 1906 a large body of lead-zinc ore was opened by Frank Kent on the Rover claim 5 miles west of Goodsprings. This claim had been located and relocated a number of times, and it was believed to be of little value. Following Kent's discovery, this claim became the nucleus of the Yellow Pine mine, the largest producer in the district. The Yellow Pine Mining Co. erected a 75-ton daily capacity zinc-lead concentrator at Goodsprings in 1911 and in the following year built a narrow-gage railroad from Goodsprings to Jean. The period of greatest activity in the district occurred during the World War, when the prices of base metals rose considerably. In 1915 the population of the camp exceeded 1,000, and, in addition to the two major producers, the Yellow Pine and Potosi mines, at least 50 smaller properties were productive.

In 1914 considerable excitement was created by the discovery of platinum in the Boss mine by Harold C. Riddall, a Goodsprings assayer. This discovery caused far more excitement than the facts justified, and a townsite in Mesquite Valley called Platina was laid out by unscrupulous promoters and a number of people were swindled.

In 1930, because of the low prices of the base metals, mining stopped, and the population dwindled to about 15 people. In recent years mining has been confined to the gold and molybdenum deposits. When the writer visited the district in February 1937 the population of the camp was about 150 people.

The production of the district is shown in table 3. In addition to the metals shown in the table, small amounts of platinum, molybdenum, cobalt, and

TABLE 3. - Gold, silver, copper, lead and zinc production from Yellow Pine (Goodsprings) District, Clark County, Nevada, 1902-1935

(Compiled by Charles White Merrill, supervising engineer,
San Francisco office, Mineral Production and Economics Division, U. S. Bureau of Mines)

| Year | Lode | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of mines | Ore, short tons | Gold | | Silver | | Copper | | Lead | |
| | | | Fine ounces | Value | Fine ounces | Value | Pounds | Value | Pounds | Value |
| 1902 | 1 | 2,078 | 2,136.97 | $ 44,175 | 342 | $ 181 | -------- | -------- | -------- | -------- |
| 1903 | 4 | 2,092 | 2,583.04 | 53,396 | 695 | 375 | 21,800 | $ 2,987 | 28,000 | $ 1,176 |
| 1904 | 1 | 1,929 | 2,316.10 | 47,878 | 146 | 85 | -------- | -------- | -------- | -------- |
| 1905 | 2 | 2,394 | 725.62 | 15,000 | 3,707 | 2,261 | -------- | -------- | 290,063 | 13,633 |
| 1906 | 5 | 9,481 | 442.63 | 9,150 | 1,573 | 1,070 | 67,341 | 12,996 | 625,175 | 35,635 |
| 1907 | 5 | 4,400 | 364.46 | 7,534 | 2,976 | 1,964 | 92,690 | 18,538 | 172,800 | 9,158 |
| 1908 | 11 | 4,627 | 376.92 | 7,792 | 10,247 | 5,431 | 42,144 | 5,563 | 720,285 | 30,252 |
| 1909 | 10 | 8,664 | 277.67 | 5,740 | 18,461 | 9,600 | 392 | 51 | 406,353 | 17,473 |
| 1910 | 16 | 5,878 | 58.97 | 1,219 | 16,826 | 9,086 | 122,925 | 15,611 | 1,263,837 | 55,609 |
| 1911 | 17 | 8,677 | 117.27 | 2,424 | 47,072 | 24,948 | 173,719 | 21,715 | 1,617,228 | 72,775 |
| 1912 | 22 | 28,386 | 1.63 | 34 | 223,013 | 137,153 | 103,398 | 17,061 | 6,544,917 | 294,521 |
| 1913 | 25 | 29,060 | 61.32 | 1,268 | 192,339 | 116,173 | 283,592 | 43,957 | 6,204,065 | 272,979 |
| 1914 | 19 | 24,537 | 383.60 | 8,033 | 122,703 | 67,855 | 156,389 | 20,800 | 4,185,208 | 163,223 |
| 1915 | 35 | 38,391 | 40.29 | 833 | 100,146 | 50,774 | 262,600 | 45,955 | 4,620,243 | 217,151 |
| 1916 | 54 | 71,155 | 693.36 | 14,333 | 156,492 | 102,972 | 494,604 | 121,673 | 8,349,850 | 576,140 |
| 1917 | 79 | 64,260 | 515.50 | 10,656 | 219,789 | 181,106 | 764,733 | 208,772 | 9,293,706 | 799,689 |
| 1918 | 38 | 40,614 | 235.52 | 4,869 | 140,211 | 140,211 | 400,792 | 98,996 | 6,459,836 | 458,643 |
| 1919 | 26 | 19,273 | 563.55 | 11,650 | 139,656 | 156,415 | 130,395 | 24,253 | 4,217,739 | 223,540 |
| 1920 | 24 | 18,611 | 158.33 | 3,273 | 96,557 | 105,247 | 76,567 | 14,088 | 3,927,280 | 314,182 |
| 1921 | 5 | 287 | 1.09 | 23 | 2,195 | 2,195 | 119 | 15 | 186,169 | 8,378 |
| 1922 | 10 | 1,861 | .95 | 20 | 6,618 | 6,618 | 52 | 7 | 316,125 | 17,388 |
| 1923 | 13 | 14,758 | 5.26 | 109 | 31,678 | 25,976 | 1,855 | 273 | 1,472,113 | 103,048 |
| 1924 | 13 | 21,383 | 7.00 | 145 | 123,650 | 82,845 | 16,267 | 2,131 | 7,710,851 | 616,868 |
| 1925 | 23 | 20,435 | 14.39 | 298 | 72,045 | 49,999 | 6,900 | 980 | 5,287,587 | 460,020 |
| 1926 | 25 | 8,931 | 15.75 | 326 | 19,549 | 12,199 | 10,994 | 1,539 | 1,904,766 | 152,381 |
| 1927 | 16 | 10,192 | 6.44 | 133 | 12,619 | 7,155 | 7,523 | 986 | 1,652,186 | 104,088 |
| 1928 | 12 | 10,745 | 6.77 | 140 | 25,793 | 15,089 | 43,955 | 6,329 | 2,209,087 | 128,127 |
| 1929 | 14 | 4,618 | 22.68 | 469 | 11,067 | 5,899 | 33,382 | 5,875 | 1,070,718 | 67,455 |
| 1930 | 11 | 6,984 | 72.31 | 1,495 | 1,031 | 397 | 18,065 | 2,348 | 965,226 | 48,261 |
| 1931 | 9 | 3,759 | 136.27 | 2,817 | 341 | 99 | 2,865 | 261 | 518,086 | 19,169 |
| 1932 | 7 | 721 | 98.27 | 2,031 | 16 | 5 | -------- | -------- | 94,795 | 2,844 |
| 1933 | 2 | 309 | 141.76 | 3,623 | 535 | 187 | -------- | -------- | 57,927 | 2,143 |
| 1934 | 7 | 5,261 | 989.28 | 34,575 | 1,437 | 928 | 4,982 | 399 | 138,405 | 5,121 |
| 1935 | 10 | 9,852 | 2,011.82 | 70,414 | 3,072 | 2,208 | 8,435 | 700 | 156,013 | 6,241 |
| Total | ------- | 504,603 | 15,587.79 | 365,875 | 1,804,597 | 1,324,706 | 3,349,475 | 694,859 | 82,671,639 | 5,297,316 |

TABLE 3. - Gold, silver, copper, lead and zinc production from Yellow Pine (Goodsprings) District, Clark County, Nevada, 1902-1935 (Continued)

(Compiled by Charles White Merrill, supervising engineer,
San Francisco office, Mineral Production and Economics Division, U. S. Bureau of Mines)

| Year | Lode | | Total value | Average recoverable value of ore per ton1/ |
|---|---|---|---|---|
| | Zinc | | | |
| | Pounds | Value | | |
| 1902 ......... | ---------- | ---------- | $ 44,356 | $ 21.35 |
| 1903 ......... | ---------- | ---------- | 57,934 | 27.69 |
| 1904 ......... | ---------- | ---------- | 47,963 | 24.86 |
| 1905 ......... | 685,659 | $ 40,454 | 71,348 | 29.80 |
| 1906 ......... | 2,885,246 | 176,000 | 234,851 | 24.77 |
| 1907 ......... | 1,878,732 | 110,845 | 148,039 | 33.65 |
| 1908 ......... | 1,115,851 | 52,445 | 101,483 | 21.93 |
| 1909 ......... | 3,013,352 | 162,721 | 195,585 | 22.57 |
| 1910 ......... | 2,707,071 | 146,182 | 227,707 | 38.74 |
| 1911 ......... | 3,548,032 | 202,238 | 324,100 | 37.35 |
| 1912 ......... | 13,254,860 | 914,585 | 1,363,354 | 48.03 |
| 1913 ......... | 14,369,709 | 804,704 | 1,239,081 | 42.64 |
| 1914 ......... | 11,862,149 | 804,970 | 864,881 | 35.25 |
| 1915 ......... | 21,061,182 | 2,611,587 | 2,926,300 | 76.22 |
| 1916 ......... | 28,889,282 | 3,871,164 | 4,686,282 | 65.86 |
| 1917 ......... | 20,535,768 | 2,094,648 | 3,294,871 | 51.27 |
| 1918 ......... | 15,444,731 | 1,405,471 | 2,108,195 | 51.91 |
| 1919 ......... | 5,974,219 | 436,118 | 851,976 | 44.21 |
| 1920 ......... | 9,381,503 | 759,902 | 1,196,692 | 64.30 |
| 1921 ......... | 69,397 | 3,470 | 14,031 | 49.06 |
| 1922 ......... | 891,174 | 50,797 | 74,830 | 40.21 |
| 1923 ......... | 8,755,427 | 595,369 | 724,775 | 49.11 |
| 1924 ......... | 7,209,042 | 514,088 | 1,216,077 | 56.87 |
| 1925 ......... | 6,230,664 | 473,530 | 984,827 | 48.19 |
| 1926 ......... | 2,181,686 | 163,626 | 330,071 | 36.96 |
| 1927 ......... | 3,546,078 | 226,949 | 339,311 | 33.29 |
| 1928 ......... | 1,425,285 | 86,942 | 236,627 | 22.02 |
| 1929 ......... | 1,236,702 | 81,622 | 161,320 | 34.93 |
| 1930 ......... | 2,474,323 | 118,768 | 171,269 | 24.52 |
| 1931 ......... | 1,899,328 | 72,174 | 94,520 | 25.14 |
| 1932 ......... | 254,795 | 7,644 | 12,524 | 17.37 |
| 1933 ......... | 23,346 | 981 | 6,934 | 22.44 |
| 1934 ......... | 28,635 | 1,231 | 42,254 | 8.03 |
| 1935 ......... | 15,380 | 677 | 80,240 | 8.14 |
| Total ....... | 193,548,608 | 16,791,902 | 24,474,658 | 48.50 |

1/ Not to be confused with average assay value.

vanadium also have been produced. A feature of the mining development in the district worthy of comment is that virtually all the properties that operated in former years either paid their own way from the start or were financed locally without benefit of outside capital.

No attempt has been made in this report to cover the district in detail. A number of reports have been written on the Goodsprings district and the interested reader is referred to the report by Hewett[12], which is the latest and most detailed.

## Zinc-Lead-Silver and Copper

In former years the principal production from the Goodsprings district has been zinc-lead ores derived from a large number of properties. The principal producers have been the Yellow Pine and the Potosi mines. Mining has been confined almost entirely to the shipping of oxidized ores obtained chiefly by selective mining and hand sorting. During the war period, dry concentrating, plants generally employing Stebbins tables, were erected at the Singer, Milford, Fredrickson, Bullion, Anchor, Sultan, Hoosier, and Christmas mines. These dry concentrating plants were fairly satisfactory, but in general the process was less efficient than wet concentration. In 1914 a roasting plant was installed at the Potosi mine to treat the zinc ores to effect a saving on freight charges. The zine-lead deposits are of the replacement type in carbonate rocks. The ratio of lead to zinc is extremely variable, ranging from nearly all zinc to nearly all lead. The zinc is in the form of mixed smithsonite, calamine, and hydrozincite, while the lead occurs as cerussite, galena, and anglesite. Some silver is associated with the zinc-lead minerals. The consensus of opinion among the miners in the district is that the combined price of lead and zinc must be above 14 cents before it is profitable to produce shipping ores. No doubt this camp will become active again if this price is maintained for any appreciable length of time.

The copper ores likewise are replacement deposits in carbonate rocks generally separated from the zinc-lead ores. Production of copper has been restricted to the shipment of higher grade material obtained by selective mining and hand sorting. When the writer visited the district in February 1937 virtually no zinc-lead or copper ores were being mined.

### Yellow Pine Mining Co.

The Yellow Pine Mining Co., controlled by S. E. Yount of Los Angeles, Calif., owns 16 patented claims in Porphyry Gulch 4 miles west of Goodsprings. This company has been the largest producer of zinc-lead ores in the Goodsprings district. It was originally organized in 1901 by J. F. Kent, and was reorganized in 1906. From 1907 to 1930 it has been a consistent producer. According to the records of the company, production from 1907 to 1925 was

---

[12] Hewett, D. F., Geology and Ore Deposits of the Goodsprings Quadrangle, Nevada; U. S. Geol. Survey Prof. Paper 162, 1931, 172 pp.

224,245 tons of ore averaging 28 percent zinc, 14 percent lead, and 12 ounces of silver per ton. The net value of this ore, F.O.B. Jean, Nev., was $27.87 per ton and the total net value was $6,253,583 out of which dividends totaling $3,030,000 were paid. The average cost of mining by the square-set method was $12.11. In 1931 the company suspended operations because of the low price of metals. When the writer visited the property in February 1937, it was under bond and lease to a Las Vegas group and several men were employed in rehabilitating the mine.

Several mills have been built at Goodsprings to treat the ores from the Yellow Pine mine. The first mill was remodeled in 1911 from a mill originally built in 1900 for the leaching of copper ores. This plant separated the lead and zinc products in the coarser sizes by Hartz jigs; the finer materials were classified in a 5-compartment Richards hydraulic classifier, and these products were treated on Overstrom tables. The capacity of the mill was 75 tons per day. This mill was more of a separator than a concentrator, since all the products were marketed except a small amount of waste rock taken off the picking belt. The mill was again remodeled in 1919, and in 1929 it was destroyed by fire. In 1930 a 125-ton flotation mill was erected, but after operating only a short time the mine and mill closed.

Mine development comprises an inclined shaft 900 feet deep and a 300-foot winze from the bottom level. The vertical depth attained in the mine is 465 feet. Total underground workings comprise 52,000 feet. Equipment at the mine includes a 310-cubic-foot-capacity, Chicago, pneumatic, single-stage compressor; a 400-cubic-foot-capacity Ingersoll-Rand Duplex compressor driven by 75-horsepower Fairbanks-Morse Diesel engine; a 50-horsepower Fairbanks-Morse geared hoist; a Sullivan drill sharpener; and all tools necessary for mining. Mill equipment included a Symons cone crusher, Hardinge ball mill, Aiken classifier, 2 Diester double-deck concentrating tables, 6 Fagergren flotation machines, Oliver filter, 2 Dorr agitators, and 2 Dorr thickening tanks. Power for milling is furnished by a 360-horsepower, 4-cylinder, Fairbanks-Morse, Diesel engine.

The ores are all oxidized and occur as irregular replacement deposits in limestone. The deposits have been disturbed considerably by faulting.

## Gold and Platinum

The gold deposits in the Goodsprings district are confined mainly to a small area in the vicinity of the Keystone mine. The principal bodies have been found in fractures in limestone or dolomite at or near the contact of granite porphyry. The Keystone mine has been the principal property, with a production of about $600,000, most of which was made in the early days. Small amounts of platinum and palladium associated with copper-gold ore are found in the Boss mine. In recent years most of the mining activity in this district has been confined to the gold deposits.

## Keystone-Barefoot Mine

The Keystone-Barefoot mine, comprising six patented claims owned by E. H. Kinney, of Albuquerque, New Mex., lies on the west slope of the Spring Mountain Range, 12 miles by road west of Goodsprings via Wilson Summit. The mine was rehabilitated in 1934 after it had lain idle for many years, and in 1935 a 40-ton flotation mill was erected at Sandy 6.7 miles west of the mine. This mill operated only a short time on ore from the Keystone-Barefoot property. In 1936 the mine was taken over under a 5-year lease by O. F. Schwartz and five partners, all from Goodsprings. In 1936 the lessees shipped 8 carloads of ore from the Barefoot claim, totaling 286.95 tons and having a gross smelter value of $12,856.90, an average of $44.81 per ton. In addition, several small sack shipments of high-grade ore having a value of about $500 per ton were made. In the early days, principally from 1892 to 1906, the Keystone is reported to have produced $600,000 and the Barefoot $50,000.

Development comprises the Keystone inclined shaft 820 feet deep, the Barefoot inclined shaft 300 feet deep, four adits, and other workings, totaling about 1 mile. Equipment includes a 22-horsepower, Fairbanks-Morse, geared hoist, a 220-foot-capacity, Ingersoll-Rand, portable compressor, a blacksmith shop, and mining tools.

The ore occurs in irregular deposits in limestone at or near a contact of granite porphyry. The values are chiefly in gold in a gangue of iron oxides, calcite, a little quartz, and in places small amounts of oxidized copper minerals.

A representative carload shipment of ore made from the Barefoot claim to the American Smelting & Refining Co. on December 19, 1936, yielded the following data:

| | | | | |
|---|---|---|---|---|
| Metal quotation: | Au | 34.9125 per oz. | | |
| Settlement assay: | Au | 1.46 oz. | | |
| | | Percent | | |
| | Cu | .52 | | |
| | Insol | 44.6 | | |
| | Iron | 28.3 | | |
| Metal payment: | 1.46 oz. Au at | 31.81825 | | $46.45 |
| Treatment charge: | Base rate | | $3.00 | |
| | 5 percent excess over $20 gr. | | 1.32 | |
| | | | 4.32 | |
| | Labor increase | | .28 | |
| | | | 4.60 | 4.60 |
| | Net value per ton .......... | | | 41.85 |
| Wet weight | Lb.<br>93,330 | | | |
| Less 9.2 percent moisture | 8,534 | | | |
| Dry weight | 84,716 | equals 42.358 tons at $41.85 per ton | | |
| | | 42.358 tons at $41.85 per ton | | $1,772.68 |
| | | Less freight advanced $5 per ton ........ | | 233.25 |
| | | Net proceeds ........................ | | 1,539.43 |

The royalty payments are 20 percent of the net smelter returns.

The hauling cost to Jean 20 miles from the mine is $3 per ton on contract.

## Boss Mine

The Boss mine, comprising a group of five patented claims owned by S. E. Yount, of Los Angeles, Calif., and associates, lies on the west side of the Spring Mountain Range, 14 miles by road west from Goodsprings. Originally located as a copper prospect in 1886, it has been worked intermittently as a source of copper, gold, and platinum. In 1900, a company erected a leaching plant at Goodsprings for the treatment of copper ores from the Boss and Columbia mines, but it was unsuccessful. In 1914, platinum and palladium were discovered in the Boss mine by H. C. Riddall. Considerable publicity was given to this discovery, and the high assays of selected platinum ore gave the impression that it was an unusually high-grade mine, which was not the case. In 1914 the Boss Gold Mining Co. was organized, and in the same year the property was sold to a syndicate headed by W. C. Price, of Los Angeles, which organized the Platinum Gold Mining Co. In 1915 the property reverted to the Boss Gold Mining Co. In 1936, after lying idle for many years, the mine was leased to Roy Myers, and in 1937 the lease was transferred to E. E. Kinney.

According to Hewett[13], production of the mine up to 1920 was 3,500 tons of ore having a gross value of $210,000. The most productive period was from 1914 to 1920, when 3,051 tons of crude ore were mined containing 1,771.81 ounces of gold, 7,014 ounces of silver, 396 ounces of platinum, 594 ounces of palladium, 568,099 pounds of copper, and 753 pounds of lead.

From March to November 1936, Myers shipped 261.87 tons of ore having a gross value of $5,086.81, an average of $19.42 per ton. This ore was obtained by screening the dumps. From December 1, 1936, to March 1937 Kinney treated 1,200 tons of dump material in the Keystone mill.

Mine is developed by five adits and other workings, totaling about 1 mile. There is no mining equipment on the property. An aerial, 2-bucket, gravity-type tram 1,000 feet long connects the upper workings with a loading bin.

The ore occurs in dolomitic limestone along a fault zone striking about northeast and southwest. Most of the ore was derived from a stope about 150 feet long, 25 feet wide, and 25 feet high above the upper tunnel level. This ore body was an irregular mass of quartz and iron oxides containing copper minerals, gold, silver, and a small amount of platinum and palladium.

A carload of screened dump ore shipped by Roy Myers on November 28, 1936, to the International Smelting and Refining Co. yielded the following data:

---

[13] Hewett, D. F., Work cited, p. 114.

| | | | |
|---|---|---|---|
| Metal quotations: | Au | $34.9125 per oz. | |
| | Ag | .77 per oz. | |
| | Cu | 10.15 less 2.525 cents per pound | |
| | | Oz. | |
| Settlement assay: | Au | .67 | |
| | Ag | 1.8 | |
| | | Percent | |
| | Cu | 2.02 | |
| | Insol | 30.0 | |
| | Fe | 6.3 | |
| | CaO | 15.4 | |
| Metal value | Au at $31.81825 | | $21.32 |
| | Ag at $.77 | | 1.32 |
| | Cu less .5 at 1.525 | | 2.32 |
| | Total | | 24.96 |
| Treatment charge: | Base charge | $3.50 | |
| | 10 percent excess over $20 gr. | .50 | |
| | | 3.50 | |
| | Labor increase | .34 | |
| | | 3.84 | 3.84 |
| | Net value per ton ...... | | 21.12 |

| | | |
|---|---|---|
| | Lb. | |
| Wet weight | 75,100 | |
| Moisture, 4.0 percent | 3,004 | |
| Dry weight | 72,096 | or 36.045 tons |

| | | |
|---|---|---|
| | 36.045 tons at $21.12 .............. | $761.33 |
| Deductions: | Freight $4.50 per ton .............. | 168.98 |
| | Net proceeds .................. | 592.35 |

The hauling cost to Jean, 22 miles from the mine, is $3 per ton on contract.

Royalty payment is 10 percent of the net smelter or mill return.

The flow sheet of the Kinney custom mill is shown in figure 6. It is at Sandy 3 miles southwest of the Boss mine. At the time of the writer's visit the mill was operating entirely on dump material from the Boss mine. Capacity of the mill is 40 tons per day. Power is furnished by a 55-horsepower Ingersoll-Rand Diesel engine and a 20-horsepower Fairbanks-Morse Diesel engine, the latter connected to a 25-kv-a generator. Water for milling is obtained from a well near the millsite.

## Chiquita Mine

The Chiquita property, comprising 18 claims (1 patented) owned by the Chiquita Mining Co., Ltd., James Maxfield, general manager, lies 12 miles by road west of Goodsprings via Wilson Summit. In the early days considerable work was done on the Chiquita and Hillside claims, but there is no record of any production. In April 1931 O. F. Schwartz and six associates, all from Goodsprings, obtained a lease and bond for $10,000 on the Chiquita and Hillside claims from the owner, A. J. Robbins of Goodsprings. The lessees discovered a body of milling ore and, after working it 1 1/2 years, sold their bond and lease to James Maxfield of Los Angeles for $80,000. The purchase price included a group of claims the lessees had located after the ore was discovered. Development work was continued by the Chiquita Gold Mining Co. Ltd., and in July 1936 a 100-ton all-slime cyanide plant was completed. When the writer visited the property 70 men were employed in the production of about 80 tons of ore per day averaging about $12 per ton.

The mine is developed by an inclined shaft 750 feet deep and other workings totaling about 2 1/2 miles. Property is completely equipped, and recently a 350-horsepower Fairbanks-Morse Diesel generating set has been installed. Water for milling is obtained from a well in Mesquite Valley and is pumped to the mill through a 4-inch-diameter pipeline 6 miles long. Total lift is 2,000 feet.

Values are chiefly gold, which occurs in irregular bodies in limestone near granite porphyry.

## Red Cloud Group

The Red Cloud group of two unpatented claims owned by John D. Loop, of Goodsprings, lies about 4 1/2 miles northwest of Goodsprings. This property was originally located in 1902, and in 1906 a small cyanide leaching plant was erected at the mine to treat the ore. According to Loop, about 2,000 tons of ore were cyanided and $10,000 in gold recovered. In 1934 the property was leased to P. S. McClanahan, who shipped 36.66 tons having a gross value of $1,726.32, an average of $47.09 per ton. In 1936 Loop shipped 26,193 tons having a gross value of $679.18, an average of $25.93 per ton. The foregoing constitute the total production.

The main shaft on the property is vertical to a depth of 116 feet, from which point it is inclined 68 degrees to a depth of 300 feet. Underground workings total 2,000 feet. The only equipment on the property is a gasoline hoist and a blacksmith shop.

The ore occurs in irregular bodies at or near the contact of a granite porphyry dike that cuts the dolomitic limestones. Values are chiefly in gold in a gangue of silicified material stained with iron oxides. An interesting feature of the property is that cinnabar was found on the upper levels associated with gold. The cinnabar, however, has not been commercially important. The smelter returns on the shipment of ore made by Loop on October 14, 1936, to the American Smelting and Refining Co. yielded the following data:

| | | | | |
|---|---|---|---|---|
| Metal quotation: | Au | 34.9125 | | |
| | | Oz. | | |
| Settlement assay: | Au | .815 | | |
| | Ag | .1 | | |
| | | Percent | | |
| | Insol | 86.4 | | |
| | Fe | 3.6 | | |
| | CaO | 2.6 | | |
| Metal value: | 0.815 oz. Au at 31.81825 | | | $25.93 |
| Treatment charge: | Base | | $3.25 | |
| | 10 percent excess over $20 gr. | | .59 | |
| | | | 3.84 | |
| | Labor increase | | .28 | |
| | | | 4.12 | 4.12 |
| | Value per ton | | | 21.81 |
| | Lb. | | | |
| Net weight | 53,620 | | | |
| Less 2.3 percent moisture | 1,234 | | | |
| Dry weight | 52,386 | 26.193 tons at $21.81 | | $571.27 |
| Deductions: | Freight, $4.50 per ton ................ | | | 120.65 |
| | Net proceeds ...................... | | | 450.62 |

The hauling cost to Jean, 12 1/2 miles from the mine, is $2 per ton on contract.

## Other Mines

The Clementina group of four unpatented claims, owned by H. A. Hogle of Salt Lake City, Utah, lies 1/2 mile southeast of the Keystone mine. At the time of the writer's visit this ground was being prospected by two men. Only a few tons of ore have been shipped from the property in former years.

Development work comprises a shaft 60 feet deep and an adit 400 feet long. Equipment includes a Fairbanks-Morse compressor (8 by 8 inches) driven by a 16-horsepower International tractor engine. Gold ore occurs in pockets in a shear zone in dolomite.

The Yellow Horse group of two patented claims and the Honduras group of four patented claims are controlled by the Minerals Exploration Co. At the time of the writer's visit this company was exploring the Yellow Horse property with a crew of three men. There is no record of any production. Development work comprises an inclined shaft 60 feet deep with about 200 feet of lateral workings. Equipment includes a 6-horsepower Fairbanks-Morse geared hoist and a one-drill Fairbanks-Morse air compressor belt-connected to a 26-horsepower Western gasoline engine. The formation is limestone intruded by granite porphyry.

## Molybdenum

Molybdenum in the form of wulfenite ($PbMoO_4$) is found in the Shenandoah, Milford, Hoosier, Mobile, Hermosa, and other mines in the district. The wulfenite occurs in small irregular deposits in limestone associated with zinc-lead ores. The only effort made to produce molybdenum concentrates was in 1935-36 when the California Molybdenum Corporation acquired the Shenandoah mine under bond and lease and erected a mill near Sandy, 3 miles from the mine. Judging from the tailings pile at the mill, about 5,000 tons of wulfenite ore were treated, but no information is available on the amount or grade of concentrates produced. The Shenandoah mine and mill reverted to the original owners in November 1936.

### Shenandoah Mine

The Shenandoah mine, owned by P. H. Springer of Las Vegas, Nev., and J. A. Fredrickson of Goodsprings, comprises a group of 13 claims (1 patented) on the west side of the Spring Mountains, 16 miles by road west from Goodsprings. This property has been intermittently worked for zinc-lead ores, principally by lessees, for many years. According to Hewett[14], production from 1908 to 1926 was 1,143 tons of shipping ore containing 2,120 ounces of silver, 208,580 pounds of lead, and 538,557 pounds of zinc.

The mine is developed by several adits, which, with lateral workings, total about 2,500 feet. The mine is near the top of a steep mountain, and an aerial gravity tramway 1,650 feet long connects the mine with the loading bins. Mine equipment has been removed from the property.

Wulfenite is present in lenses in brecciated zones in limestone. According to Fredrickson, the ore mined by the California Molybdenum Corporation was found in a block of ground 130 feet long, 160 feet high, and from 10 to 30 feet wide. The zinc-lead ore minerals are cerussite, galena, smithsonite, and hydrozincite.

The Shenandoah mill has a capacity of 50 tons of wulfenite ore per day. Concentration was effected by tabling followed by flotation. Mill equipment includes an Eimco ball mill (4 by 5 feet), Dorr simplex classifier, 2 Deister tables, trommel (5 by 2 1/2 feet, equipped with 8-mesh screen), 12 M. S. flotation cells, an Eimco filter, and other equipment. Primary crushing was done at the mine. The power plant at the mill consists of a 180-horsepower, 4-cylinder, Diesel engine connected to a 170-kv-a alternator and a 75-horsepower, Fairbanks-Morse, 2-cylinder, Diesel engine connected to a 56-kv-a alternator. A power line connects the mine with the power plant.

Water for milling is available at the millsite from a well 186 feet deep, lined with 6-inch casing, and equipped with a 52-gallon-per-minute-capacity, Pomona, deep-well, turbine pump connected to a 5-horsepower motor. The corrugated iron stand tank near the well has a capacity of 16,000 gallons.

---

[14] Hewett, D. F., Work cited.

## Vanadium

Vanadates of lead, zinc, and copper have been found on the Spelter, Hoodoo, Whale, Valley Forge, Velvet, Akron, and a number of other properties in the Goodsprings district. All of the vanadium deposits in the district were found while prospecting was being done for zinc-lead ores.

The production of vanadium has been about 50 tons of hand-sorted shipping ore containing about 10 percent $V_2O_5$, and 200 tons of milling ore averaging about 1.6 percent $V_2O_5$. The largest shipment was made in 1918 by Charles Kennedy from the Lookout mine on the east side of the Spring Mountain Range. This shipment contained 35 tons and averaged 9.26 percent $V_2O_5$. In 1923 an unsuccessful attempt was made to concentrate vanadium ore on the Spelter property by gravity methods. In 1936, 182 tons of vanadium ore mined from the Spelter and Hoodoo properties were treated at the Kinney custom mill by flotation. From the 182 tons of ore averaging 1.65 percent $V_2O_5$, 6.6 tons of concentrates were produced containing 16.7 percent $V_2O_5$, 43.3 percent lead, 3 percent copper, and some zinc. Since the recovery of vanadium on this test run was only 36.8 percent, the mill would not accept further shipments of vanadium ores.

All the vanadium deposits are in brecciated zones in limestone or dolomite. The principal vanadium minerals are vanadinite ($3Pb_3V_2O_8.PbCl_2$), descloizite ($4RO,V_2O_5.H_2O$;R=Pb,Zn, usually in the approximate ratio 1 to 1), and cuprodescloizite ($(Pb,Zn,Cu)(VO_4)_2(Pb,Zn,Cu)(OH)_2$), associated with limonite, galena, and oxidized lead and zinc minerals.

In general, the vanadium ores are too low-grade to be shipped crude. With the present stage of development, no single property in this area is capable of producing sufficient vanadium ore to keep a 25-ton daily capacity concentrator operating steadily. However, the writer is of the opinion that if the properties were worked by lessees they could, together, supply sufficient ore averaging better than 1 percent $V_2O_5$ to keep a 25-ton mill busy. The mill would have to be operated on a custom basis. The various economic factors involved in an enterprise of this nature would have to be investigated further.

Laboratory milling tests made on vanadium ores from the Goodsprings district by the U. S. Bureau of Mines Experiment Station at Rolla, Mo., indicate that the ores are amenable to concentration by the flotation process. In continuous, closed-circuit milling a recovery of 80 to 85 percent of the vanadium minerals appears feasible.

Because of the complex nature of the vanadium minerals the concentrates require a special treatment process to reduce them to finished products. The U. S. Bureau of Mines Experiment Station at Reno, Nev., has made some tests on the reduction of the vanadium concentrates along the lines of caustic fusion, direct smelting, and leaching with sulphuric acid. The interested reader is referred to the report on the results of these tests made by Doerner[15].

---

[15] Doerner, H. A., Metallurgical Possibilities of the Descloizite Ores at Goodsprings, Nev.: Rept. of Investigations 2433, Bureau of Mines, 1923, 19 pp.

## Spelter Group

The Spelter group of four unpatented claims, incorporated under the name of Master Alloy Mining and Milling Co., Rex C. Ewing, Goodsprings, Nev., principal owner, lies 9 miles southwest of Goodsprings on the west slope of the Spring Mountain Range. These claims were located originally for lead and zinc, but there is no record that these minerals were produced. In 1923 an attempt was made to concentrate the vanadium ore in a small mill equipped with crusher, rolls, screens, and four Wilfley tables. About 3 1/2 tons of vanadium concentrates averaging 11 percent $V_2O_5$ were produced and sold to Elmer H. Hester of Kingman, Ariz. In 1936, 72 tons of vanadium ore averaging 1.84 percent $V_2O_5$ were treated in the Keystone Custom mill at Sandy.

Property is developed by three tunnels which, with lateral workings, total about 1,000 feet. There is no equipment on the property.

The ore occurs in a brecciated zone in limestone striking east and west and having a maximum width of 25 feet. The vanadium occurs as vanadanite and descloizite associated with galena. Lenses of ore up to 6 feet in width are said to contain from 1 to 2 percent $V_2O_5$. Two cut samples taken by the writer over widths of 20 and 25 feet analyzed .25 and .45 percent $V_2O_5$, respectively.

## Hoodoo Group

The Hoodoo group of four unpatented claims, incorporated under the name of the Kansas Nevada Mining Co., controlled by Frank Williams of Goodsprings, adjoins the Spelter group on the southeast. This property was located originally for zinc-lead, and it has been worked intermittently for a number of years on a small scale. According to Hewett[15], the production of crude zinc-lead ore from 1911 to 1927 was 335 tons containing 523 ounces of silver, 33,831 pounds of lead, and 189,954 pounds of zinc. According to Williams, 16 tons of vanadium ore, averaging 4 percent $V_2O_5$ were sold to Elmer H. Hester, Kingman, Ariz., in 1928. In 1936 110 tons containing 1.52 percent $V_2O_5$ were treated in the Keystone custom mill at Sandy.

Development work comprises three adits and other workings totaling about 2,000 feet. There is no equipment on the property.

Vanadates occur in lenses in a shear zone in limestone. Three cut samples taken by the writer over widths from 5 to 9 feet contained 0.67, 0.68, and 1.18 percent $V_2O_5$.

## Whale Group

The Whale group of six unpatented claims owned by Frank Miller of Goodsprings lies on the west slope of the Spring Mountain Range, 8 miles by road west of Goodsprings. This property has been worked intermittently for

---

[16] Hewett, D. F., Work cited, p. 152.

zinc-lead ore. According to Hewett[17], from 1912 to 1917, 537 tons of crude ore were shipped, containing 265,368 pounds of zinc, 21,238 pounds of lead, and 98 ounces of silver. The first discovery of vanadium ore was made on this property by Frank Miller in 1912 while prospecting for zinc-lead. No vanadium ore has been produced.

A deposit of zinc-lead has been prospected by an adit and subsidiary workings totaling about 500 feet. The vanadium deposits have been prospected by two shallow shafts, several short adits, and numerous open-cuts totaling about 250 feet of workings. The latter work on vanadium deposits was done while prospecting for lead-zinc ore.

The vanadium occurs chiefly as cuprodescloizite in shear zones in limestone. Small amounts of galena, calamine, and wulfenite are present. Vanadium showings have been found in irregular deposits in at least 20 places scattered over an area 60 feet wide and 1,000 feet long. There is no continuity to the deposits. A general sample of dump material taken by the writer from 10 open-cuts analyzed 1.12 percent $V_2O_5$, and another sample of dump material near a shallow shaft analyzed 0.73 percent $V_2O_5$. By selective mining the grade of the ore probably could be maintained above 1 percent vanadium pentoxide.

## Valley Forge Group

The Valley Forge (formerly known as the Hickory Dick) group of four unpatented claims, owned by Frank Williams of Goodsprings, lies 2 miles west of Columbia Summit and 6 miles southwest of Goodsprings. This property was located originally for copper, and during the World War four carloads of copper ore was mined and shipped. Vanadium ore has not been produced.

Development work on the copper showings comprises 250 feet of adits and other workings. The vanadium deposits have been prospected by five open-cuts totaling not more than 50 feet. There is no equipment on the property.

Vanadates (chiefly cuprodescloizite) occur in brecciated zones in limestone over widths of 12 to 15 feet. Several samples were taken by the writer; one sample of dump material analyzed 0.72 percent $V_2O_5$ and a cut sample taken over a width of 3 feet on the hanging-wall side of a deposit 15 feet wide analyzed 1.26 percent $V_2O_5$. With a small amount of work done, the showings are encouraging.

## Velvet Group

The Velvet group of three unpatented claims, owned by Charles Kennedy of Goodsprings, lies on the north side of Table Mountain, 8.7 miles by road southwest of Goodsprings. Nothing has been produced from the property.

Development comprises an adit 50 feet long and other scattered workings totaling about 100 feet. Vanadates, principally vanadinite and descloizite, occur in a shear zone in limestone. A channel sample taken by the writer across a width of 3 feet in the face of the adit analyzed 0.79 percent $V_2O_5$.

---

[17] Hewett, D. F., Work cited, p. 146.

## Akron Group

The Akron group of three patented claims, owned by Charles Beck of Goodsprings, adjoins the Valley Forge group on the west. The Bill Nye claim, formerly a separate property, constitutes part of the Akron group. These claims originally were located for zinc-lead. According to Hewett[18], production from the Bill Nye claim from 1914 to 1919 was 1,488 tons of crude ore containing 6,360 pounds of copper, 62,564 pounds of lead, 921,931 pounds of zinc, and a little silver and gold. Production from the Akron claim has been four carloads of zinc-lead-silver ore and 7 tons of vanadium ore containing about 7 percent $V_2O_5$.

Development comprises several shafts, the deepest of which is 220 feet inclined 76°, and other workings totaling about 1,000 feet. Virtually all the development work has been done in the search for zinc-lead ore. There is no equipment on the property.

Vanadates, chiefly cuprodescloizite, occur in brecciated dolomitic limestone on the Akron claim.

## Cobalt

Cobalt, in the form of stainierite $(Co,Fe,Al)_2O_3.H_2O$), occurs in a number of mines in the Goodsprings district. The only production was made in 1921-22, when a number of small lots aggregating 21 tons, containing 5.13 to 29.18 percent and averaging 8.73 percent cobalt, were shipped from the Blue Jay, Columbia, Copper Chief, and Highline properties. Although the presence of cobalt is rather widespread in the area, the deposits so far described have been small. In recent years the only prospecting done for cobalt was on the Swansea property.

## Swansea Group

The Swansea group of three unpatented claims, owned by Frank Williams of Goodsprings, lies about 1 mile west of Columbia Summit. This property was located originally for copper, and 4 years ago it was relocated for cobalt. None has been produced.

Development consists of several short adits totaling not more than 100 feet of workings. There is no equipment on the property. The stainierite occurs as irregular replacement deposits in limestone. It is associated with considerable calcite. About 4 tons of ore on the dump was reported to contain 3 1/2 percent cobalt.

---

[18] Hewett, D. F., Work cited, p. 146.

Digitized by Google Original from THE OHIO STATE UNIVERSITY

## JEAN DISTRICT

(Silica Sand, Radium, Limestone)

Silica sand, radium (carnotite), and limestone occur in the vicinity of Jean, a station on the Union Pacific R.R. 30 miles by road a little west of south of Las Vegas, Nev.

The only production from the district has been small amounts of silica sand and limestone. The carnotite occurrences have been of more mineralogical than commercial interest.

### Nevada Pacific Minerals Co.

A large deposit of silica sand occurs in T. 24 S., R. 60 E., M.D.M., 2.7 miles northwesterly from Sutor Siding. Sutor Siding is on the main line of the Union Pacific R.R. about 4 1/2 miles north of Jean, Nev.

In August 1936 the Nevada Pacific Minerals Co. of Los Angeles, Calif., E. S. McCurdy, president, started to work the deposit, and up to January 1937 had shipped 25 cars of silica sand for molding purposes. Due to lack of water in the vicinity of the deposit no silica sand has been produced for the better grades of glassware. An average of three men is employed,

The sand occurs in a sandstone formation exposed in a well-rounded hill. The sandstone bed mined consists largely of white quartz grains stained with iron oxide on the bedding planes and in the seams. At the surface the sandstone is cemented with lime.

Mining is done by open-cut method. The sandstone is fairly well consolidated, and jackhammers with detachable Carr bits and 7/8-inch hollow hexagonal steel are used for drilling. Blasting is done with 40-percent gelatin-dynamite No. 6 detonaters and tape fuse. Compressed air is furnished by a portable Ingersoll-Rand compressor. Water for mining and domestic purposes is hauled from Las Vegas in railroad cars to Sutor Siding and then trucked to the camp.

The broken sandstone is shoveled by hand into wheelbarrows equipped with rubber tires and transported a short distance to a bin. From the bin it is fed to a Blake type crusher (8 by 15 inches) set to crush to 1/4-inch size. The crusher discharges into a boot of a belt and bucket elevator that discharges into a trommel equipped with 1/4-inch and 16-mesh screens. The plus 1/4-inch and minus 16-mesh products, which constitute about 10 percent of the material mined, is rejected as waste. The minus 1/4-inch and plus 16-mesh products drop into a bin, from whence they are loaded into trucks and hauled to the railroad. The sandstone is crushed and sized dry. Power for the plant is furnished by a 30-horsepower Waukesha semi-Diesel engine.

## Radium Deposits

Carnotite was discovered several miles west of Sutor Siding in 1931 by J. Isachsen, formerly of Jean, Nev. Following Isachsen's discovery, other deposits were located in the vicinity.

The carnotite, associated with manganese oxide, occurs as a coating in fractures in sandstone and limestone. Although prospecting has been carried on by a number of shallow shafts, trenches, and open-cuts, the amount of carnotite found was too small to be of commercial importance.

## Limestone Deposit

A limestone quarry about 1 mile southeast of Jean, Nev., on Sheep Mountain, was opened by the Blue Diamond Gypsum Co. about 10 years ago. After 850 tons of lime rock had been shipped, the quarry was abandoned.

## LAS VEGAS DISTRICT

### (Manganese)

The Las Vegas district is 16 miles southeast of Las Vegas, Nev. Manganese was discovered here in September 1917 by R. N. Edwards, B. R. Jefferson, and J. F. Marrs of Las Vegas, who located the Three Kids group of claims. Shortly after, a local group formed the Manganese Association, and production was begun in November 1917. In 1918 the Three Kids mine and the adjoining Las Vegas group were purchased by Thomas Thorkildson of Los Angeles, Calif., but the name of the company was retained. The Manganese Association worked the property until March 1919. The property remained idle until 1936, when it was acquired by Los Angeles interests, who formed the Boulder Dam Manganese Co. Production during the war was about 16,000 tons of shipping ore that averaged 40 percent manganese.

Interest in these manganese deposits was revived in 1936 because of the research work carried on by the U. S. Bureau of Mines on the electrodeposition of metallic manganese from an electrolyte obtained by leaching manganese ore[19].

## Boulder Dam Manganese Co.

The Boulder Dam Manganese Co., H. R. Golenor of Los Angeles, president, and G. R. Boggs, of Los Angeles, vice president and consulting engineer, controls the principal properties in the Las Vegas manganese district, comprising 11 claims, two of which are patented.

Development work comprises a number of shallow shafts and inclines, none over 100 feet deep, and several short tunnels. There is no equipment on the property. In February 1937 the property was idle.

---

[19] Koster, J., and Shelton, S. M., Electrolytic Manganese: Eng. and Min. Jour., vol. 137, October 1936, pp. 510-513.

During the World War mining was done by either open-cuts or the room-and-pillar system. Where the overburden was comparatively thin it was broken up and removed by horse-drawn scrapers and the ore was mined by open-pit methods; where the overburden became too thick to be handled economically, the room-and-pillar system of mining was employed. According to Hale[20], the first 31 carloads of ore shipped from the Three Kids property averaged as follows:

| | Percent |
|---|---|
| Mn | 41 |
| $SiO_2$ | 11 |
| P | 0.03 |
| Fe | 1 |
| Moisture | 11.62 |

In 1936 the Boulder Dam Manganese Co. explored its holdings by diamond drilling. As a result of this work, ore was blocked out as follows:

| | Tons ore (2,000 lb.) | Mn content, percent | Ave. thickness, feet |
|---|---|---|---|
| Block A | 83,000 | 35.33 | 34 |
| Block B | 228,000 | 30.5 | 37 |
| Block C | 65,000 | 18.5 | 20 |
| Three Kids | 100,000 | 31.0 | 20 |
| Total | 476,000 | 29.81 | |

The metal content of the ore blocked out is 141,889 tons of metallic manganese.

The geology of the Las Vegas manganese deposit has been described by Pardee and Jones[21] and Hewett and Webber[22].

According to Hewett and Webber, the Las Vegas manganese deposits are of sedimentary origin. The formation in the vicinity consists of numerous volcanic flows, breccias, and tuffs. The overlying stratified materials that contain the beds of manganese oxides are largely reddish-brown tuffs, with conglomerate of volcanic material and gypsum beds. Drill records show the average thickness of the overburden to be about 26 feet.

The manganese oxides, chiefly wad and psilomelane, occur as soft porous material weighing about 80 pounds per cubic foot. The thickness of the bed varies from a few feet to a maximum of 60 feet. The bed has been disturbed by faulting. The ore is homogeneous, and a high-grade product cannot be obtained by sorting or selective mining. Lenses of sandy material and seams of fibrous gypsum ranging in thickness from a few inches to 2 feet occur in the manganese bed. This material is easily separated from the ore in mining.

---

[20] Hale, Fred A., Jr., Manganese Deposits of Clark County, Nev.: Eng. and Min. Jour., vol. 105, 1918, p. 776.

[21] Pardee, J. T., and Jones, E. L., Jr., Deposits of Manganese Ore in Nevada: U. S. Geol. Survey Bull. 710, 1920, pp. 209-242.

[22] Hewett, D. F., and Webber, B. N., Bedded Deposits of Manganese Oxides Near Las Vegas, Nev.: Nevada University Bull., vol. 25, 1931, 17 pp.

### Ebony Queen Claim

Manganese occurs 2 miles northwest of Boulder City, Nev., near Hemmingway Pass on the Ebony Queen unpatented claim relocated by J. R. Sailor and G. H. Miller of Las Vegas, Nev., in January 1937. This deposit was explored about 1925 by several open-cuts totaling about 50 feet of work. Nothing has ever been produced.

The deposit striking northwest and southeast and dipping 75° outcrops for several hundred feet along the side of a small hill. Material consists of a mixture of iron and manganese oxide ranging from 4 to 10 feet in width. No information on the manganese content is available.

## MOAPA DISTRICT

(Gypsum, Volcanic Ash)

The Moapa district is in the vicinity of Moapa, Nev., a station on the Union Pacific R.R. that connects Los Angeles, Calif., and Salt Lake City, Utah. Gypsum and volcanic ash occur in this area but the only production has been gypsum.

### Gypsum Deposits

From 1919 to 1923 the White Star Plaster Co. exploited a gypsum deposit 3 1/2 miles east of Moapa. The White Star mill originally contained two 10-foot, oil-fired, calcining kettles, but the plant was enlarged to be a 3-kettle mill in 1922. During 1922 shipments of plaster to Los Angeles, Calif., averaged about 3,000 tons per month[23].

In 1923 the company ceased operations, and no work has been done on the deposits since.

Two beds of gypsum occur in limestone, but only the lower bed was exploited. This bed is from 30 to 40 feet thick, dips about 30°, and is exposed for several thousand feet.

In the Muddy River Valley, about 5 miles south of Moapa, lies the Anderson gypsum deposit. Strata of gypsum interbedded with shale outcrop for a distance of 3 miles. Within a gypsiferous zone several hundred feet thick are strata of rock gypsum apparently containing no anhydrite. The principal gypsum bed is from 10 to 60 feet thick, and it could be mined at low cost.

---

[23] Lincoln, Francis Church, Mining Districts and Mineral Resources of Nevada: Mackay Sch. Mines Bull., 1923, pp. 22-23.

The nearest railroad point is Jackson Siding, 4 miles east of the deposit, on the St. Thomas branch of the Union Pacific R.R. About 20 years ago the Rex Plaster Co. shipped a small amount of gypsum from this deposit to a plant in Los Angeles.

## Volcanic Ash Deposit

A deposit of volcanic ash owned by the Dotson Bros., Mart and Henry, of Logandale, Nev., occurs 13.6 miles northwest of Moapa. The deposit is covered by four unpatented lode claims.

The volcanic ash occurs as a horizontal bed about 30 inches thick, exposed on a side of a bluff for a distance of about 1 mile. The material is uncemented, fine-grained, and gray in color. No effort has been made to work the deposit.

## Tin Deposit

In 1936 tin was reported to have been found about 13 miles southeast of Moapa, Nev. The Cosmo Mining Co. acquired a large group of claims and some stock was sold. Pieces of sandstone stained with manganese, said to contain tin, were taken by the writer. A composite sample of the material was analysed by the Mackay School of Mines laboratory at Reno, Nev., but no tin was found.

## MUDDY MOUNTAINS DISTRICT

### (Borates, Gypsum, Silica Sand, Bentonite, Sodium Sulphate)

Deposits of borates, gypsum, silica sand, bentonite, and sodium sulphate occur in the southern part of the Muddy Mountains in eastern Clark County north of Lake Mead. The only production of any consequence has been from the borate deposits. The non-metallic deposits that occur in the northern part of the Muddy Mountains are described in this paper under the Moapa and St. Thomas districts.

The borate deposits, which occur chiefly as colemanite ($Ca_2B_6O_{11}.13H_2O$), are of interest in that they constitute the only commercial occurrences of this mineral in the United States outside of California. These deposits were discovered in 1920 and 1921 and were exploited from 1922 to 1928. In the latter year operations ceased, due to the discovery of a new boron mineral, kernite ($Na_2B_4O_7.4H_2O$), near Kramer, San Bernardino County, Calif. Because of the different types of borate deposits that have been worked successively in the United States, the borax industry has been very unstable, and at every stage of development different processes of exploitation were devised.

In the United States the industry began with the discovery of borax ($Na_2B_4O_7.10H_2O$) by John A. Veatch in the waters of Tuscan Springs, Tahama County, Calif. Doctor Veatch extended his search, and other deposits were found in the same year on the east side of Clear Lake, Calif. The borax from hot springs and Clear Lake constituted the chief source of supply in the United States for many years. In the early seventies, when the lake deposits of California were virtually exhausted, borax and ulexite ($NaCaB_5O_9.H_2O$) were discovered in the desert playas in Nevada and California. These playa deposits were worked up to 1887, when the industry was revolutionized by the discovery of colemanite beds near Death Valley, San Bernardino County, and later in Inyo and Los Angeles Counties, Calif. The latest development in the domestic borax industry was the discovery of extensive deposits of kernite, which supplanted colemanite in much the same manner as colemanite supplanted the playa deposits of borax and ulexite. Kernite has a smaller content of water of crystallization than the borax of commerce, so that when it is recrystallized to borax the original weight is increased.

## Borate Deposits

Borates occur in two localities 13 miles apart in the southern end of the Muddy Mountains. One deposit is in the White Basin, 20 miles by automobile road southeast of Crystal, Nev., and the other is near Callville Wash, 26 miles by road east of Lovell Siding on the Union Pacific R.R.

The White Basin colemanite deposit was discovered by John F. Perkins of Overton, Nev., in 1920. Shortly after, the Perkins group of 12 claims was sold to the Pacific Coast Borax Co. Subsequently other locations were made in the vicinity, which were acquired by the American Borax Co. This company operated from 1922 to 1924, when operations ceased because of litigation with the Pacific Coast Borax Co. Since 1924 there has been no borax activity in this area.

Development work done by the American Borax Co. includes an inclined shaft and several hundred feet of lateral workings. The calcining plant erected by this company near the mine has been dismantled.

According to Noble[24], colemanite occurs in bunchy lenticular layers interbedded with white shale containing gypsum, beds of volcanic ash, or thin layers of limestone. Some of the limestone shows a peculiar concretionary structure called "goose eggs," and these concretions are believed by the prospectors to indicate the presence of boron minerals. The colemanite beds vary in thickness from a few inches to 3 feet.

Stimulated by the discovery of borates in the White Basin, F. M. Lovell and George D. Hartman of St. Thomas, Nev., who were prospecting under a grubstake agreement, discovered the Callville Wash colemanite deposit on January 23, 1921. As soon as it became known that the deposit was valuable, a number of intending purchasers tried to purchase the property, but they were outplayed by F. M. (Borax) Smith, who, in the early days, was the dominating personality in the borax industry of the world. Smith, after examining the property, made an offer and arranged an initial deposit of $50,000 to bind the bargain. The contract was drawn up in the field on the leaf of a notebook, and the purchase price is said to have been $250,000. In July 1922 the West End Chemical Co., of which Smith was the leading figure, established a camp and began production. In 1928 operations ceased because the colemanite could not compete with the kernite deposits mined by the Pacific Coast Borax Co. near Kramer, Calif.

---

[24] Noble, L. F., Colemanite in Clark County, Nev.: U. S. Geol. Survey Bull. 735-B, 16 pp.

According to J. W. Wilson of Las Vegas, Nev., formerly superintendent of the property (which is known as the Anniversary mine), the production of crude colemanite averaging about 20 percent $B_2O_3$ from 1922 to 1928 was about 200,000 tons. During the period of greatest activity 175 tons of crude ore were mined per day, and from this amount of ore about 65 tons of calcines were obtained averaging about 40 percent $B_2O_3$. The calcines were hauled 24 miles to the railroad and shipped to refineries on the Pacific coast.

The West End Chemical Co. owns a group of 21 lode claims, 12 of which are patented. The lode claims are also covered by seven placer locations.

Entry to the Anniversary mine is made by two adits. Underground workings comprise approximately 7,000 feet. An electrically operated aerial tramway 12,000 feet in length was employed for transporting the ore from the portal of the main adit to the calcining plant, 250 feet lower than the adit elevation. Calcining equipment comprises two rotary, oil-fired, double-tube kilns, each 60 feet long and 6 feet outside diameter. The inner chamber of each kiln is 3 feet in diameter. Indirect firing was employed in the kilns. The annular space between the two tubes constituted the firing chamber. Power for mining and milling was furnished by a 4-cylinder, Fairbanks-Morse, Y-type, Diesel engine connected to a generator. The mine workings, camp, and equipment are still intact and in fairly good condition. It is reported that nearly $2,000,000 was invested in this property.

The geology of the Anniversary mine has been described by Noble[25] and by Callaghan and W. W. Rubey[26]. The colemanite bed dips from 45° to 60°, averaging 50°, and is traceable on the surface for a distance of about 3,000 feet. It is interbedded with shale and limestone in a synclinal basin whose axis trends east and west. The width of the bed ranges from 6 to more than 22 feet, the average minable width being about 8 feet. According to Callaghan and Rubey, the ore reserves are at least 400,000 tons.

The shrinkage-stope method of mining was employed. Due to the fact that colemanite breaks into tabular pieces, its angle or repose is greater than that usually encountered in metalliferous deposits. Where the bed was steep enough, the stopes were kept filled with broken colemanite, and in the flatter portions as much ore as possible was retained in the stopes and small pillars or ore were left for support at irregular intervals. The only timber used in mining was for manways and chutes, the latter spaced at intervals of 20 feet. Where the colemanite bed was too flat to permit the ore to run readily, the final cleaning up of the stopes was effected by scrapers. About 90 percent of the ore was recovered in mining. The ore was trammed by hand in 1-ton cars to the tramway loading terminal at the portal of the main adit.

---

[25] Noble, L. F., Work cited.

[26] Callaghan, Eugene, and Rubey, W. W., Mineral Resources of the Region Around Boulder Dam: U. S. Geol. Survey Bull. 871, 1936, pp. 106-113.

At the calcining plant the ore was crushed to 1-inch size and fed to the two rotary kilns. The calcined material was discharged on an electric vibrating screen, which separated the colemanite from most of the associated impurities. The separation of colemanite from the impurities is possible by screening because of the fact that the former disintegrates to a fine powder while the latter do not. The screened product, averaging about 40 percent $B_2O_3$, was hauled in trucks to the railroad for shipment.

## Gypsum Deposits

Gypsum occurs in the Muddy Mountains about 2 1/2 miles southwest of Comstock, Nev. The deposit is 3 1/2 miles from the Union Pacific R.R. C. C. McDonald, of Overton, Nev., and associates own 320 acres, and the Pacific Portland Cement Co. owns 640 acres, the latter purchased from McDonald in 1922. Prior to purchasing the property, the Pacific Portland Cement Co. explored the deposit by diamond drilling. The gypsum bed is 150 feet thick and dips 45°. At a depth of about 100 feet the gypsum changes to anhydrite. Analyses indicate that the material is nearly pure.

Deposits of gypsum and gypsite occur several miles from Lake Mead on the east side of Boulder Wash, which drains into Lake Mead at the east end of Boulder Canyon. The gypsum and gypsite outcrop over an area of several square miles, but no attempt has ever been made to exploit the deposits because of their inaccessibility. When the water in Lake Mead rises to the crest of Boulder Dam the gypsum can be transported readily by barge to Boulder City, 12 miles distant.

## Silica-Sand Deposits

An extensive deposit of white silica sand occurs on the west side of the Muddy Mountains, 8 miles southwest of Crystal, Nev. The deposit is covered by the Lucy Etta group of five unpatented placer claims, totaling 800 acres owned by C. D. Wyatt of Boulder City, Nev. The former loading station of the American Borax Co. on the Union Pacific R.R. at Crystal is 8 miles from the deposit. The freight rate to Los Angeles, Calif., is $2.30 per ton and to San Francisco $3.60 per ton. No water is available for a washing plant in the vicinity of the deposit. The only production has been four carloads of sand shipped, without treatment, to the Technical Glass Co. of Los Angeles in 1934, that analyzed as follows:

Digitized by Google Original from THE OHIO STATE UNIVERSITY

| | Percent |
|---|---|
| Calcium | 0.042 |
| Iron | .022 |
| Aluminum | .22 |
| Magnesium | .045 |
| Silica | 99.04 |

Both white and pink varieties of sand occur on the Wyatt claims in a sandstone formation. The white sand is loosely consolidated and when crushed consists largely of very fine grains.

Silica in the form of quartzite occurs 13 miles northwest of Crystal in the Arrow Canyon Mountains. The deposit is owned by Seth E. Evans of Goodsprings, Nev., and in 1936 it was under lease to W. M. Tiffany of Long Beach, Calif. While this deposit is not in the Muddy Mountains area, it is included here for convenience. Very little work has been done on the deposit and there is no information on any production.

The silica grains are tightly cemented and the exploitation of this deposit depends on using the material in lump form as ganister or for purposes requiring lump silica. Under the glass the silica appears virtually free from any impurities.

## Bentonite Deposits

Small deposits of bentonite types of clay occur in the Muddy Mountains area. One of the deposits, covered by three unpatented lode claims owned by Robert A. Baker of Las Vegas, Nev., is northwest of Muddy Peak 9 miles southeast of Crystal. Development work consists of a shaft 30 feet deep and several scattered open-cuts. The bentonite occurs between limestone and sandstone, and the width varies from 6 to 14 feet. None has ever been produced.

## Sodium Sulphate Deposit

A deposit of sodium sulphate owned by B. R. McKenna of Moapa, Nev., outcrops along the side of a prominent cliff in the White Basin about 3 miles south of the former American Borax Co. mine. It is accessible by poor automobile road from Crystal, Nev., a station on the Union Pacific R. R., 24 miles to the northwest. No attempt has been made to exploit the deposit. The sodium sulphate is intimately associated with siliceous impurities.

## ST. THOMAS (VIRGIN RIVER) DISTRICT

(Silica Sand, Magnesite, Gypsum, Salt, Sodium Sulphate)

The St. Thomas or Virgin River district comprises a large, vaguely defined area in the vicinity of St. Thomas, Nev. The town of St. Thomas has been abandoned, as eventually it will be flooded by the water impounded by Boulder Dam. The district is particularly rich in industrial mineral deposits, including silica sand, magnesite, gypsum, salt, and sodium sulphate; but due to their inaccessibility and distance from consuming centers, only silica sand and salt have been produced. The salt deposits have been worked mainly to supply local demand. The Los Angeles & Salt Lake R.R., a part of the Union Pacific System, passes through Moapa, Nev., 14 miles northwest of Overton. From Moapa a branch railroad runs southeast to St. Thomas, a distance of 21 miles. About 5 miles of the southern part of this branch line will be abandoned when the water in Lake Mead reaches its maximum flow line.

The production of silica sand in Clark County is a comparatively recent industry, having been established less than 10 years. Production statistics are not available, but the total from the St. Thomas deposits is probably more than 200,000 tons. During the first quarter of 1937 the average monthly production was 3,500 tons, consisting of 2,500 tons of washed white sand and 1,000 tons of pink sand, the latter shipped without treatment. The bulk of the white sand was produced by the Morledge and Veitch Co., formerly the Sparton Silica Co.

Both white and pink varieties of silica sand occur in the sandstone formations in the Valley of Fire northwest of St. Thomas. These sandstone beds of Jurassic age and of great thickness have been eroded into fantastic shapes that exhibit many hues of red, yellow, brown, pink, and white, which, in the bright light and heat of the desert, give the Valley of Fire its name.

In Clark County the production of a white glass sand suitable for the better grades of glassware depends upon a supply of water for washing to remove small amounts of clay, iron, and amorphous silica. Although extensive deposits occur in other parts of the County, it is doubtful whether they can produce a high-grade glass sand without washing. In the St. Thomas area, water for washing is available from the Muddy River, which joins the Virgin River a little below St. Thomas.

With the present import tariff of $1 per long ton on silica sand, the St. Thomas deposits compete with imported Belgian sand in the growing glass and foundry industries of southern California. The white sand, after washing, is suitable for the manufacture of fancy glassware and sodium silicate; the pink variety is shipped without treatment and is used for molding purposes and manufacture of the cheaper grades of colored glassware. Production of silica sand in Clark County is on a close-margin basis at the present time, with a chance to expand if industries requiring this material are established in the vicinity of Boulder Dam.

### Morledge & Veitch Co.

The white silica-sand deposit owned by F. L. Morledge and Lloyd Veitch is covered by two placer locations of 40 acres each 3.8 miles southwest of the washing plant. The washing plant is on the St. Thomas branch of the Union Pacific R.R. 5 miles south of Overton, Nev. In March 1937, 25 men were employed in the production of about 2,500 tons of white sand per month. Production for the past 3 years, taken from the company records, has been as follows:

| Year | Tons (2,000 lb.) |
|---|---|
| 1934 | 16,180 |
| 1935 | 14,935 (closed 4 months) |
| 1936 | 18,717 |

The deposit occurs in a small hill covered by capping of iron-stained and cemented detrital material varying in thickness from a few feet to 20 feet. Below the overburden the sandstone consists of rounded crystalline grains fairly uniform in size and loosely consolidated. The sandstone is firm enough so that explosives are necessary to reduce it to a size convenient for handling. However, a light blow will reduce the lump to fragments, and the sandstone disintegrates rapidly in water. The mine-run sand contains about 20 percent waste in the form of hard lumps, clay, and amorphous silica.

A representative analysis made by the Smith Emery Co. of Los Angeles, Calif., on the washed sand was as follows:

| | Percent |
|---|---|
| Silica | 99.290 |
| Iron oxide | .051 |
| Aluminum oxide | .220 |
| Titanium oxide | .050 |
| Calcium oxide | .090 |
| Magnesium oxide | .020 |
| Sodium and potassium oxide | .100 |
| Loss on ignition | .180 |
| Total | 100.001 |

The tolerance for iron in silica sand is 0.05 percent when used for better grades of glass, and according to Morledge the finished sand can be maintained within this limit. Some of the sand is shipped for the manufacture of sodium silicate, and for this purpose the iron content is not so important as it is in glass sand. The glass trade desires a product fairly uniform in grain size.

In the initial stages of mining, the overburden is first removed with a horse-drawn scraper, after which the sand is blasted and loaded directly into trucks by hand shoveling. Most of the sand mined in the past has been taken from an open pit approximately 240 feet long, 80 feet wide, and 100 feet deep. From this pit the sandstone is broken to a convenient shoveling size with 12-percent Hercomite No. 6. Holes are drilled with hand augers. The sandstone is hand-shoveled into end-dump mine cars holding 1,500 pounds each and is trammed to a loading pocket at one end of the pit. A skip holding about 3/4-ton, traveling on rails, and operated by Continental hoist powered by 35-horsepower gasoline engine, is used to hoist the sand out of the pit. The skip dumps on a rail grizzly with 5-inch openings. The grizzly oversize contains some hard lumps of silica cemented with clay, and these are hand-sorted and rejected as waste. From the bin below the grizzly the sand is loaded into 5-ton trucks and hauled to the washing plant. The flow sheet of the washing plant is shown in figure 7.

The sandstone is crushed to 1/2-inch size by a set of rolls. It is disintegrated further by the action of water sprays in the trommel screen. Iron is present in the sand as nodules of ferruginous material resistant to disintegration, so that much of it is eliminated in the trommel oversize.

By successive washings in drag classifiers, the amorphous silica and clay are rejected. In the washing plant the coarser and finer sands are separated by hydraulic and drag classifiers. A screen test on the three sizes of sand produced was as follows:

| Retained on (screen size) - | 20 | 40 | 60 | 80 | 100 | -100 |
|---|---|---|---|---|---|---|
| Molding sand ................ | 0.5 | 49.1 | 30.6 | 7.2 | 6.3 | 6.8 |
| Glass sand .................. | Trace | 13.9 | 44.4 | 18.6 | 14.1 | 9.2 |
| Sodium silicate sand ........ | .0 | Trace | 11.8 | 18.4 | 29.2 | 39.6 |

The finished product is dried in the air on a concrete storage platform. After it is dry it is loaded into railroad cars by a portable belt conveyor.

Power for the treatment plant is supplied by a 50-horsepower Western gasoline engine. The capacity of the plant is 10 tons of finished product per hour.

## Nevada Silica Sand Co.

A deposit of white silica sand worked by the Nevada Silica Sand Co. is 4 miles west of Tokio Siding, a station on the St. Thomas branch of the Union Pacific R.R. several miles north of Overton, Nev. The deposit, which covers 160 acres, is worked under lease from the owner, Fay Perkins of Overton. The Nevada Silica Sand Co. is controlled by H. J. Stocker of Las Vegas, Nev., and associates.

The washing plant is 5 1/2 miles from the deposit, at a place 1 1/2 miles south of Tokio Siding, where water is available. Several years ago a pneumatic classification plant was erected at the deposit but it proved to be unsuccessful. In the latter part of 1936 eight men were engaged in producing silica sand. Judging from the extent of the open-pit working, the total amount of sand produced from this deposit has been approximately 15,000 tons.

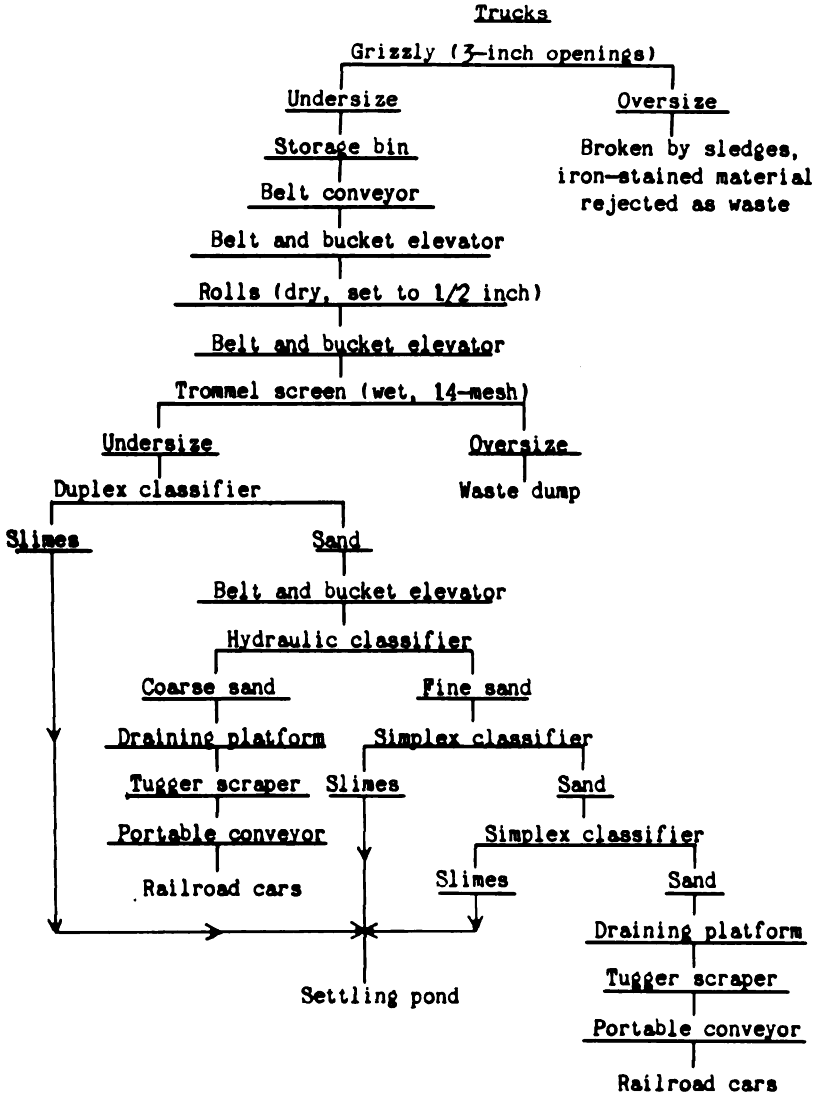

Figure 7.- Flow sheet of Morledge-Veitch silica-sand washing plant near Overton, Clark County, Nev.

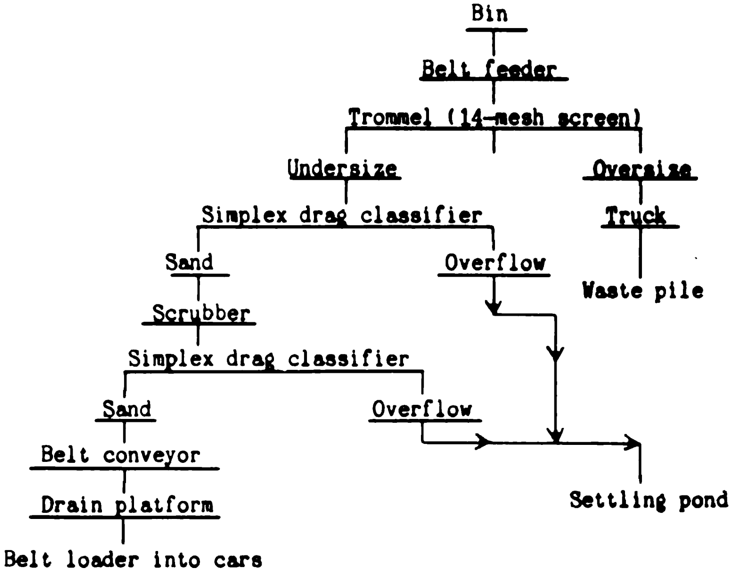

Figure 8.- Flow sheet of the Nevada Silica Sand Co. washing plant near Tokio Siding, Clark County, Nev.

The deposit is covered by an iron-stained sandstone capping whose depth ranges from a few feet to 10 feet. Below this capping the sand is fairly uniform in texture, loosely cemented, and in places stained with iron oxide. When the writer visited the property in November 1936 the workings comprised an open pit 100 feet long, 75 feet wide, and about 40 feet deep at the lower end. As depth is attained, the sandstone will probably contain less iron-stained material.

Mining is done with a 1/3-cubic-yard-capacity dragline scraper operated by a 35-horsepower, 4-cylinder, gasoline engine. The sand is broken with Hercomite No. 6 explosives. Hand-drilling is employed. The dragline transports the broken sandstone to an elevated bin equipped with rail grizzly having 5-inch openings. Some of the grizzly oversize is either iron-stained or too hard to be broken easily by hand-sledging, and this material is rejected by hand-sorting. The grizzly undersize drops into a 9- by 12-inch Blake-type crusher, which reduces it to a minus 1-inch product. From the bin the sand is loaded into either of two International trucks holding 3 and 4 tons, respectively, which haul it to the washing plant. The flow sheet of the washing plant is shown in figure 8.

From the mill bin, a belt-feeder delivers the sand to a trommel 3 1/2 feet in diameter and 8 feet in length equipped with a 14-mesh screen and water sprays. The trommel oversize is rejected as waste. The trommel undersize is discharged into a home-made simplex drag classifier. The classifier sand passes into a scrubber consisting of a wooden cylinder 5 feet in diameter and 18 feet long, which turns at a speed of 18 revolutions per minute. The scrubber discharges into a second home-made simplex drag classifier, which makes the finished product. The finished product is carried by belt conveyor to a draining platform, and after the sand is drained and dried in the open air it is loaded directly into railroad cars by belt loader.

The capacity of the washing plant is 60 tons of finished product in 9 hours with a crew of three men. Power for the plant is furnished by a 40-horsepower gasoline engine.

## Other Silica-Sand Deposits

W. R. Cozart, of Overton, Nev., owns 800 acres of white silica sand several miles southwest of Overton. Only 112 carloads of this sand has been mined and was shipped in 1927-28. In 1937 this deposit was under lease to Paul and Fred Nunn, who were engaged in constructing a washing plant on the St. Thomas branch of the Union Pacific R.R. several miles south of Overton.

There is deposit of wind-blown pink sand (owned by U. V. Perkins of Overton, Nev.) 3 1/2 miles west of Logandale, Nev. The deposit is covered by two unpatented claims under lease to Morledge & Veitch Co., who were shipping about 500 tons of sand per month. This deposit consists of sand fairly uniform in grain size and with a silica content averaging about 97 percent. The material is shoveled by hand into trucks and hauled 3 1/2 miles to a railroad spur for shipment.

In addition to the foregoing deposits, a number of small operators ship pink sand intermittently from dune deposits several miles west of Kaolin, Nev. The pink sand is used in the manufacture of colored glassware and for foundry purposes, and it is shipped without treatment. The deposits of pink sand are large and production is limited only by lack of market.

## Magnesite Deposits

Extensive deposits of impure magnesite occur on the northeast side of the Muddy Mountains, 5 miles by road west of Kaolin, Nev., a station on the St. Thomas branch of the Union Pacific R.R. Magnesite claims were first located in 1915, although the deposits probably were known prior to that time because of their conspicuous outcrops.

The Success group of six unpatented lode claims, also covered by a placer location, is owned by Mrs. John F. Perkins, the Gentry estate, and others. The Prosperity group of five unpatented lode claims is owned by John F. Perkins and associates. The South group of three unpatented lode claims is held by Levi Syphus and associates. Most of the owners live at Overton, Nev.

The deposits have been prospected by a number of adits but no commercial shipments of magnesite have been made.

A detailed report of the geology of these magnesite deposits has been made by W. W. Rubey and Eugene Callaghan[27].

The magnesite occurs in white, fine-grained, sedimentary beds interbedded with white clayey dolomite and ranging in dip from 25° to 42°.

According to Rubey and Callaghan, the estimated tonnage of the magnesite in the Overton area is as follows:

| Minimum grade of ore | Magnesite (short tons) | | | |
|---|---|---|---|---|
| | In beds 4 feet or more thick | In beds 2 feet or more thick | In beds 1 foot or more thick | In beds 6 inches or more thick |
| 38 percent of MgO | 290,000 | 430,000 | 760,000 | 850,000 |
| 34 percent of MgO | 3,100,000 | 3,500,000 | 3,600,000 | 3,700,000 |
| 30 percent of MgO | 4,500,000 | 4,900,000 | 5,000,000 | 5,100,000 |

These deposits have received attention as a source of magnesium in connection with the power from Boulder Dam. When the reservoir (Lake Mead) formed by Boulder Dam reaches its maximum flow line, the magnesite deposits will be only a short distance from the shore of the lake. To be commercially valuable, the lime and silica impurities that occur in the magnesite would have to be removed by some method of beneficiation. The magnesite is so fine-grained that physical methods of separating it from the impure constituents do not appear feasible.

---

[27] Rubey, W. W., and Callaghan, Eugene, Mineral Resources of the Region Around Boulder Dam: U. S. Geol. Survey Bull. 871, 1936, pp. 119-139.

## Gypsum Deposits

There are large reserves of gypsum on the east side of the Virgin River, 10 miles below St. Thomas, Nev. Although the fact that these deposits were there has been known for many years, they have not been mined due to their inaccessibility and distance from market. However, when the water in Lake Mead reaches its maximum flow line the gypsum can easily be transported by barges to the Union Pacific R. R. at Boulder City. Very little work has been done on the deposits.

The Colorado River Exploration Co. owns nine patented claims comprising 1,440 acres. Another group of 11 unpatented claims of 160 acres each is owned by C. C. McDonald, of Overton, Nev., and associates.

## Salt Deposits

Remarkable deposits of rock salt are exposed on the cliffs along the west side of the Virgin River for a distance of 10 miles south from a point 4 miles below St. Thomas, Nev. These deposits have been acquired by the Federal government, since they will eventually be submerged as the water rises in the reservoir behind Boulder Dam.

The salt beds were mined by a tribe of Indians living in the Virgin River Valley about 1,500 years ago. Evidence of this ancient mining activity may be seen on the walls or floors of a natural cave in one of the salt mountains 4 miles below St. Thomas. The Indians mined the salt by chipping circular channels with stone hammers and prying off the slabs. A number of stone hammers found in the cave by archeologists may be seen in the Lost City museum, a short distance south of Overton, Nev.

White men mined salt in this locality as far back as 1866 in order to supply salt for the chlorination mills in the Mineral Park district, Ariz., and the Eldorado Canyon district, Nev. Although the salt deposits are virtually inexhaustible, little has been produced because of transportation difficulties and distance from large markets in competition with other sources of supply.

About 1932 some rock salt was shipped to Los Angeles by a company called the Virgin River Salt Co. Judging from the old workings, no large amount of salt was produced. For many years an average of about 200 tons of salt has been mined annually to satisfy local demands for stock purposes. This salt is very desirable for stock use because it weathers slowly.

In February 1937 the Civilian Conservation Corps at Moapa, Nev., was engaged in hand-mining the salt for stock use. Several thousand tons of this salt will be mined and stored before the deposits are flooded.

The salt bed of probably greatest commercial value is 4 miles south of St. Thomas and is about 100 feet thick. It is covered with a coating of sand and silt, but under this coating it is hard and solid and in order to be mined must be blasted. Some specimens of the salt are nearly as transparent as plate glass, but the bulk of it is mixed with clay and silt.

## Sodium Sulphate (Glauberite) Deposit

Sodium sulphate (glauberite) occurs on the west side of the Virgin River about 5 miles south of St. Thomas. This deposit is on patented land formerly owned by the Stewart brothers. This land has been purchased by the Federal Government, since it will be submerged when water rises to the crest of Boulder Dam. The deposit has been explored by an adit 200 feet long, near the end of which is a winze 40 feet deep. No production has ever been made.

The sodium sulphate occurs as a crystalline mass of glauberite in horizontal sedimentary beds. Composite samples of the material analyzed 46.8 percent sodium sulphate, 45.85 percent calcium sulphate, and 7.35 impurities, including sodium chloride, iron, alumina, and silica. Glauberite when pure is composed of 51.1 percent sodium sulphate and 48.9 percent calcium sulphate, and the foregoing samples indicate that the deposit is fairly pure. The reserves are probably large.

## SEARCHLIGHT DISTRICT

### (Gold, Silver)

The Searchlight district is in southeastern Clark County, 40 miles south of Boulder City, Nev., and 22 miles east of Nipton, Calif. Nipton, on the main line of the Union Pacific R.R., is the nearest shipping point. The town of Searchlight, with a population of about 200, is 16 miles west of the Colorado River at an elevation of 3,600 feet.

The first claims in this area were located in 1897 by G. F. Colton, John Swickard, and others. The first important discovery was made on the Searchlight claim, now part of the Duplex mine, and the Quartette mine was discovered shortly after. The latter was financed by Col. C. Hopkins of Buffalo, N. Y. In 1902 the Quartette Mining Co. erected a 20-stamp mill on the Colorado River, 16 miles east, and built a narrow-gage railroad to connect the mine and the mill. In 1903 water was encountered in the Quartette shaft and a second mill of 20-stamp capacity was built at Searchlight.

The greatest activity occurred from 1902 to 1916, during which period a large number of companies were organized, many of which were merely stock-selling ventures. From 1916 to the present time mining has been principally in the hands of lessees. In 1936 an average of 60 men were employed on various properties in the district.

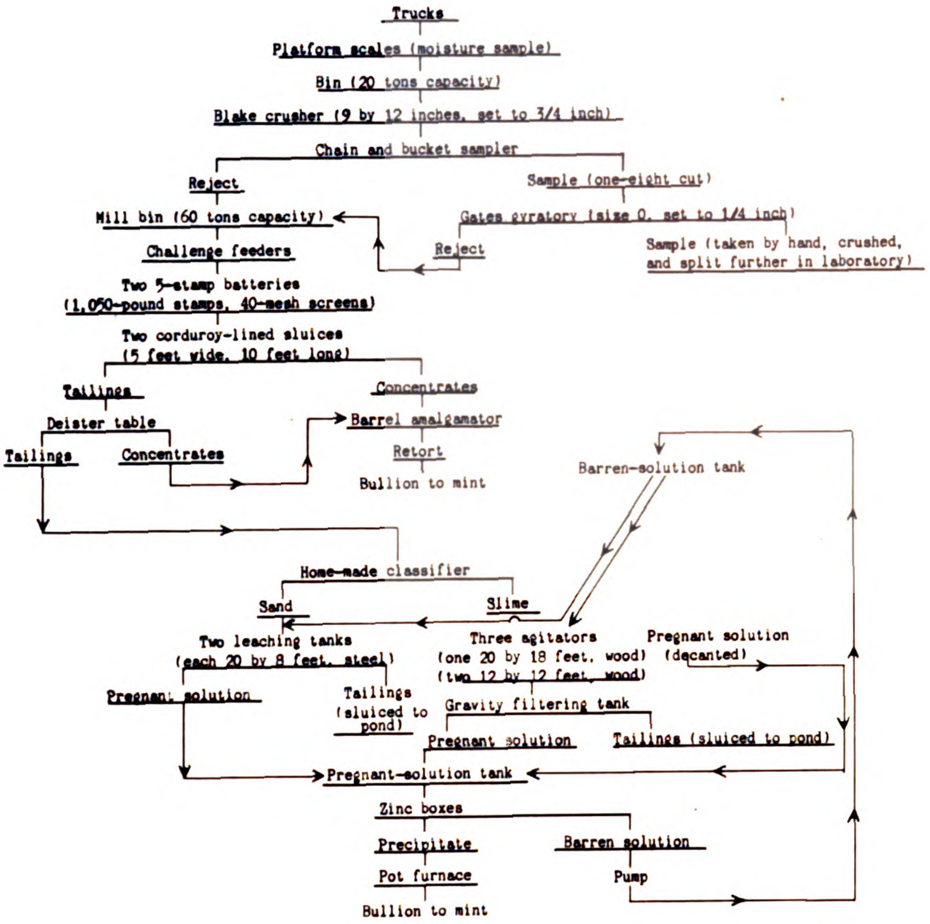
Trucks
Platform scales (moisture sample)
Bin (20 tons capacity)
Blake crusher (9 by 12 inches, set to 3/4 inch)
Chain and bucket sampler
Reject
Sample (one-eight cut)
Mill bin (60 tons capacity)
Gates gyratory (size 0, set to 1/4 inch)
Challenge feeders
Reject
Sample (taken by hand, crushed, and split further in laboratory)
Two 5-stamp batteries (1,050-pound stamps, 40-mesh screens)
Two corduroy-lined sluices (5 feet wide, 10 feet long)
Tailings
Concentrates
Deister table
Barrel amalgamator
Tailings
Concentrates
Retort
Bullion to mint
Barren-solution tank
Home-made classifier
Sand
Slime
Two leaching tanks (each 20 by 8 feet, steel)
Three agitators (one 20 by 18 feet, wood) (two 12 by 12 feet, wood)
Pregnant solution (decanted)
Pregnant solution
Tailings (sluiced to pond)
Gravity filtering tank
Pregnant solution
Tailings (sluiced to pond)
Pregnant-solution tank
Zinc boxes
Precipitate
Barren solution
Pot furnace
Pump
Bullion to mint

Figure 9.- Flow sheet of Kelsey custom mill, Searchlight district, Clark County, Nev.

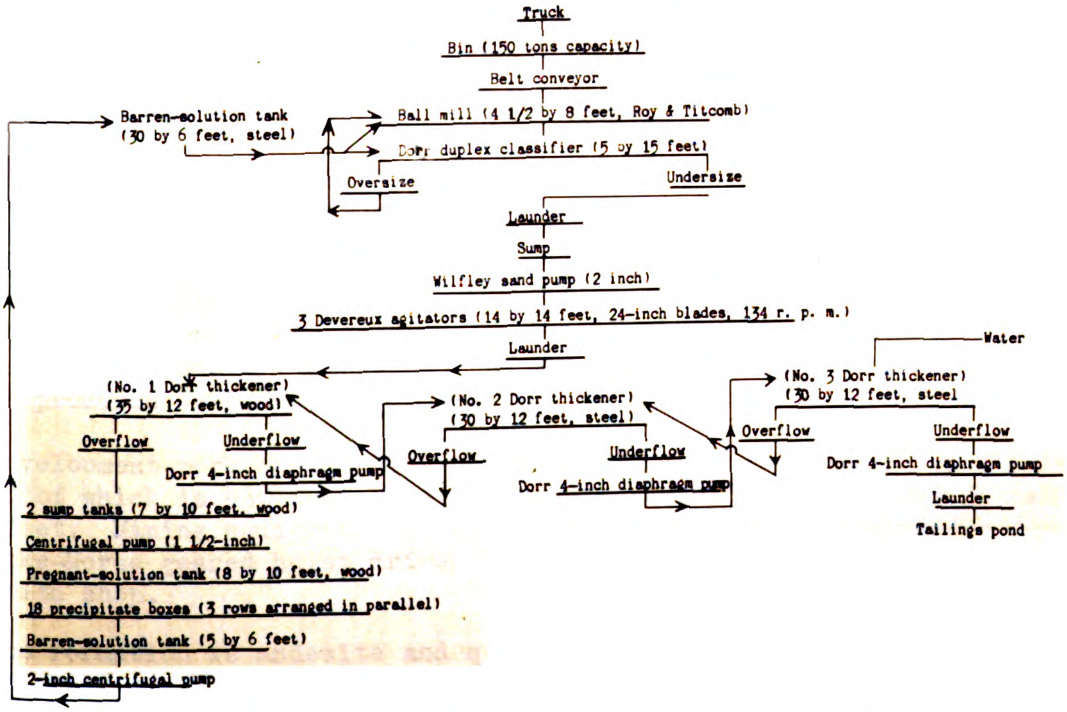
Truck
Bin (150 tons capacity)
Belt conveyor
Barren-solution tank (30 by 6 feet, steel)
Ball mill (4 1/2 by 8 feet, Roy & Titcomb)
Dorr duplex classifier (5 by 15 feet)
Oversize
Undersize
Launder
Sump
Wilfley sand pump (2 inch)
3 Devereux agitators (14 by 14 feet, 24-inch blades, 134 r. p. m.)
Water
Launder
(No. 1 Dorr thickener) (35 by 12 feet, wood)
(No. 2 Dorr thickener) (30 by 12 feet, steel)
(No. 3 Dorr thickener) (30 by 12 feet, steel)
Overflow
Underflow
Dorr 4-inch diaphragm pump
Overflow
Underflow
Dorr 4-inch diaphragm pump
Overflow
Underflow
Dorr 4-inch diaphragm pump
Launder
Tailings pond
2 sump tanks (7 by 10 feet, wood)
Centrifugal pump (1 1/2-inch)
Pregnant-solution tank (8 by 10 feet, wood)
18 precipitate boxes (3 rows arranged in parallel)
Barren-solution tank (5 by 6 feet)
2-inch centrifugal pump

Figure 10.- Flow sheet of Mollin Mining Co. cyanide plant, Searchlight district, Clark County, Nev.

The mineralized area in the vicinity of Searchlight is 3 miles long and 1 mile wide. The ore occurs in fissure veins near a major fault contact between quartz monzonite and Tertiary eruptives. The fissures contain very little quartz, and the pay ore usually is a mass of shattered country rock or gouge material stained with iron oxides and carrying free gold associated with copper and lead minerals generally oxidized. Production of the district is shown in table 4.

A number of properties at Camp Thurman, Camp Dupont, Black Mountain, and Newberry Mountain are included in this report under the Searchlight district.

## Custom Milling

The Kelsey custom mill at Searchlight, owned by W. H. Kelsey, was built in the latter part of 1935 to treat custom ores derived from various properties within the Searchlight area. The capacity of the mill is 30 tons per 24 hours, but the supply of ore has been insufficient to permit steady operation of the mill. In 1936 an average of 400 tons or ore, valued at from $7 to $100 per ton, were treated per month.

The flow sheet of the mill is shown in figure 9. A crew of four men is required to operate the mill on a one-shift-per-day basis. The cost of the plant, with all used equipment excepting the stamps, which were new, but including laboratory and assay office, was $20,000. Power for milling is furnished by a 100-horsepower, Fairbanks-Morse, Y-type, 3-cylinder, Diesel engine. Water for milling is pumped from the Santa Fe shaft near the mill. Custom milling charge is $4 per ton, and payment is made for 90 percent of the assay value of the gold estimated at $33 per ounce and 90 percent of the assay value of the silver less one ounce at 70 cents per ounce.

## Blossom Mine

The Blossom mine, comprising five patented claims, is owned by William H. Crozier of Los Angeles, Calif. This mine, originally part of the Southern Nevada property, was purchased by Crozier at a tax sale several years ago. In 1936 the western portion of the mine was leased to A. S. Gaines and Chris Kirkeby of Searchlight, Nev. During the last 6 months of 1936 the lessees had shipped 27 carloads of ore averaging about $100 per ton. An average of 12 men are employed. In the early days the mine is reported to have produced $325,000.

Development work on the Blossom property comprises several shafts, the deepest of which is 430 feet, and other workings, totaling in all about 2,000 feet. Mining equipment on the Gaines-Kirkeby lease includes a Fairbanks-Morse geared hoist driven by 6-horsepower gasoline engine and blacksmith shop.

The formation is andesite and quartz monzonite. In former years the production of the Blossom mine was derived from a blanket vein averaging

TABLE 4. - Gold, silver, copper, and lead production from Searchlight District, Clark County, Nevada, 1904-1935

(Compiled by Charles White Merrill, supervising engineer,
San Francisco office, Mineral Production and Economics Division, U. S. Bureau of Mines)

| Year | Placer | | | | | | Lode | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of mines | Gold | | Silver | | Total value | No. of mines | Ore, short tons | Gold | |
| | | Fine ounces | Value | Fine ounces | Value | | | | Fine ounces | Value |
| 1904 | ------ | ------------ | ------ | ------------ | ------ | ------ | 3 | 16,750 | 13,401.17 | $330,386 |
| 1905 | ------ | ------------ | ------ | ------------ | ------ | ------ | 6 | 38,069 | 19,329.44 | 399,575 |
| 1906 | ------ | ------------ | ------ | ------------ | ------ | ------ | 5 | 45,668 | 25,144.60 | 519,785 |
| 1907 | ------ | ------------ | ------ | ------------ | ------ | ------ | 6 | 45,921 | 23,440.98 | 484,568 |
| 1908 | ------ | ------------ | ------ | ------------ | ------ | ------ | 7 | 52,193 | 13,137.34 | 271,573 |
| 1909 | ------ | ------------ | ------ | ------------ | ------ | ------ | 8 | 68,931 | 16,236.83 | 335,645 |
| 1910 | ------ | ------------ | ------ | ------------ | ------ | ------ | 13 | 27,331 | 10,405.32 | 215,097 |
| 1911 | ------ | ------------ | ------ | ------------ | ------ | ------ | 10 | 1,850 | 966.48 | 19,979 |
| 1912 | ------ | ------------ | ------ | ------------ | ------ | ------ | 9 | 4,153 | 2,237.05 | 46,244 |
| 1913 | ------ | ------------ | ------ | ------------ | ------ | ------ | 15 | 5,989 | 6,653.84 | 137,547 |
| 1914 | ------ | ------------ | ------ | ------------ | ------ | ------ | 5 | 3,057 | 3,998.53 | 82,657 |
| 1915 | ------ | ------------ | ------ | ------------ | ------ | ------ | 13 | 7,765 | 4,984.66 | 103,042 |
| 1916 | ------ | ------------ | ------ | ------------ | ------ | ------ | 15 | 6,322 | 3,902.75 | 80,677 |
| 1917 | ------ | ------------ | ------ | ------------ | ------ | ------ | 14 | 12,866 | 3,444.93 | 71,213 |
| 1918 | ------ | ------------ | ------ | ------------ | ------ | ------ | 14 | 1,700 | 2,649.06 | 54,761 |
| 1919 | ------ | ------------ | ------ | ------------ | ------ | ------ | 9 | 6,980 | 2,854.37 | 59,005 |
| 1920 | ------ | ------------ | ------ | ------------ | ------ | ------ | 7 | 2,131 | 3,432.35 | 70,953 |
| 1921 | ------ | ------------ | ------ | ------------ | ------ | ------ | 9 | 1,182 | 3,600.65 | 74,432 |
| 1922 | ------ | ------------ | ------ | ------------ | ------ | ------ | 7 | 1,441 | 1,661.29 | 34,342 |
| 1923 | ------ | ------------ | ------ | ------------ | ------ | ------ | 6 | 1,142 | 1,006.93 | 20,815 |
| 1924 | ------ | ------------ | ------ | ------------ | ------ | ------ | 2 | 850 | 830.12 | 17,160 |
| 1925 | ------ | ------------ | ------ | ------------ | ------ | ------ | 5 | 2,833 | 3,313.93 | 68,505 |
| 1926 | ------ | ------------ | ------ | ------------ | ------ | ------ | 4 | 1,881 | 1,879.42 | 38,851 |
| 1927 | ------ | ------------ | ------ | ------------ | ------ | ------ | 4 | 106 | 334.90 | 6,923 |
| 1928 | ------ | ------------ | ------ | ------------ | ------ | ------ | 3 | 77 | 223.78 | 4,626 |
| 1929 | ------ | ------------ | ------ | ------------ | ------ | ------ | 3 | 184 | 105.26 | 2,176 |
| 1930 | ------ | ------------ | ------ | ------------ | ------ | ------ | 3 | 124 | 19.40 | 401 |
| 1931 | ------ | ------------ | ------ | ------------ | ------ | ------ | 8 | 20,855 | 3,276.29 | 67,727 |
| 1932 | ------ | ------------ | ------ | ------------ | ------ | ------ | 7 | 2,973 | 2,018.41 | 41,724 |
| 1933 | ------ | ------------ | ------ | ------------ | ------ | ------ | 10 | 2,996 | 912.58 | 23,326 |
| 1934 | 1 | 8.32 | $ 291 | ------------ | ------ | $ 291 | 24 | 6,701 | 1,745.52 | 61,006 |
| 1935 | 1 | 2.96 | 10,656 | ------------ | ------ | 10,656 | 35 | 29,617 | 3,825.62 | 133,897 |
| Total | 2 | 11.28 | 10,947 | ------------ | ------ | 10,947 | ----- | 420,644 | 185,973.80 | 3,928,618 |

TABLE 4. - Gold, silver, copper, and lead production from Searchlight District, Clark County, Nevada, 1904-1935 (Continued)

(Compiled by Charles White Merrill, supervising engineer, San Francisco office, Mineral Production and Economics Division, U. S. Bureau of Mines)

| Year | Lode | | | | | | | Average recoverable value of ore per ton[1] | Total value (lode and placer) |
|---|---|---|---|---|---|---|---|---|---|
| | Silver | | Copper | | Lead | | Total value | | |
| | Fine ounces | Value | Pounds | Value | Pounds | Value | | | |
| 1904 | 13,245 | $ 7,682 | ------- | ----- | ------- | ----- | $ 338,068 | 23.17 | $ 388,068 |
| 1905 | 28,528 | 17,402 | 22,808 | $ 3,558 | 12,064 | $ 567 | 421,102 | 11.06 | 421,102 |
| 1906 | 11,543 | 7,849 | 11,182 | 2,158 | 9,655 | 550 | 530,342 | 11.61 | 530,342 |
| 1907 | 7,494 | 4,946 | 37,063 | 7,413 | 38,113 | 2,020 | 498,947 | 10.87 | 498,947 |
| 1908 | 10,917 | 5,786 | 14,954 | 1,974 | 44,857 | 1,884 | 281,217 | 5.39 | 281,217 |
| 1909 | 13,544 | 7,043 | 22,916 | 2,979 | 36,209 | 1,557 | 347,224 | 5.04 | 347,224 |
| 1910 | 11,489 | 6,204 | 93,848 | 11,919 | 45,847 | 2,017 | 235,237 | 8.61 | 235,237 |
| 1911 | 2,136 | 1,132 | 12,095 | 1,512 | 7,659 | 345 | 22,968 | 12.42 | 22,968 |
| 1912 | 2,562 | 1,576 | 10,126 | 1,671 | 10,032 | 451 | 49,942 | 12.01 | 49,942 |
| 1913 | 5,903 | 3,565 | 53,971 | 8,365 | 61,006 | 2,684 | 152,161 | 25.41 | 152,161 |
| 1914 | 2,855 | 1,579 | 5,556 | 739 | 21,919 | 855 | 85,830 | 28.08 | 85,830 |
| 1915 | 3,546 | 1,798 | 20,970 | 3,670 | 35,562 | 1,671 | 110,181 | 14.19 | 110,181 |
| 1916 | 4,340 | 2,856 | 24,392 | 6,000 | 9,951 | 687 | 90,220 | 14.27 | 90,220 |
| 1917 | 9,073 | 7,476 | 98,923 | 27,006 | 59,453 | 5,113 | 110,808 | 8.61 | 110,808 |
| 1918 | 8,395 | 8,395 | 44,477 | 10,986 | 77,863 | 5,528 | 79,670 | 46.86 | 79,670 |
| 1919 | 5,502 | 6,162 | 18,074 | 3,362 | 39,307 | 2,083 | 70,612 | 10.12 | 70,612 |
| 1920 | 5,275 | 5,750 | 44,941 | 8,269 | 91,436 | 7,315 | 92,287 | 43.31 | 92,287 |
| 1921 | 9,877 | 9,877 | 31,128 | 4,016 | 98,048 | 4,412 | 92,737 | 78.46 | 92,737 |
| 1922 | 5,024 | 5,024 | 12,847 | 1,734 | 44,375 | 2,441 | 43,541 | 30.22 | 43,541 |
| 1923 | 2,708 | 2,221 | 22,150 | 3,256 | 47,651 | 3,336 | 29,628 | 25.94 | 29,628 |
| 1924 | 1,267 | 849 | 5,801 | 760 | 46,050 | 3,684 | 22,453 | 26.42 | 22,453 |
| 1925 | 2,586 | 1,795 | 14,974 | 2,126 | 86,768 | 7,549 | 79,975 | 28.23 | 79,975 |
| 1926 | 1,720 | 1,073 | 7,430 | 1,040 | 81,977 | 6,558 | 47,522 | 25.26 | 47,522 |
| 1927 | 306 | 174 | 1,429 | 187 | 10,415 | 656 | 7,940 | 74.91 | 7,940 |
| 1928 | 252 | 147 | 1,929 | 278 | 8,991 | 521 | 5,572 | 72.36 | 5,572 |
| 1929 | 58 | 31 | 654 | 115 | 2,743 | 173 | 2,495 | 13.56 | 2,495 |
| 1930 | 27 | 10 | ------- | ----- | ------- | ----- | 411 | 3.31 | 411 |
| 1931 | 5,826 | 1,690 | 6,022 | 548 | 274,687 | 10,163 | 80,128 | 3.84 | 80,128 |
| 1932 | 4,853 | 1,369 | 4,353 | 274 | 355,458 | 10,664 | 54,031 | 18.17 | 54,031 |
| 1933 | 1,182 | 414 | 2,261 | 145 | 12,040 | 445 | 24,330 | 8.12 | 24,330 |
| 1934 | 8,478 | 5,477 | 2,237 | 179 | 4,951 | 183 | 66,845 | 9.98 | 67,136 |
| 1935 | 12,317 | 8,853 | 9,195 | 763 | 72,271 | 2,891 | 146,404 | 4.94 | 157,060 |
| Total | 202,828 | 136,205 | 658,706 | 117,002 | 1,747,358 | 89,003 | 4,270,828 | 10.15 | 4,231,775 |

[1] Not to be confused with average assay value.

3 feet in width and outcropping around the sides of a small hill. This form of deposit is unique in the district, as all the other deposits are inclined veins of the fissure type. On the Gaines-Kirkeby lease the vein varies in width from a few inches to 15 inches, and the values occur in crushed andesite and gouge. Most of the ore has been mined between the surface and the 110-foot level. Values are chiefly in gold and silver.

Because of the erratic distribution of values the ore is mined by irregular workings with little regard for development. There are no pronounced structural features to distinguish the vein material, and constant panning is necessary to distinguish between ore and waste. In places where the ore is continuous the resuing method of mining is employed. In February 1937 the inclined shaft had reached a depth of 160 feet. The ore is hoisted in a bucket (600 pounds capacity) sliding on skids. The ground is soft and drilling is done with hand augers or hand steel.

A shipment of ore made by A. S. Gaines and Chris Kirkeby to the U. S. Smelting & Refining Co. on November 20, 1936, furnished the following information:

| | | | | |
|---|---|---|---|---|
| Metal quotation: | Au at | $34.9125 | | |
| | Ag at | .77 | | |
| | | Oz | | |
| Settlement assay: | Au | 3.845 | | |
| | Ag | 47.62 | | |
| | | Percent | | |
| | Insol. | 83.4 | | |
| | Fe | 3.2 | | |
| | S | .2 | | |
| | Lime | 1.0 | | |
| Metal payment | 100 percent Au at $32.3183 | | $124.26 | |
| | Ag at .77 | | 36.67 | |
| | Total metal value | | 160.95 | |
| | Less 5 percent value of Ag | | 1.83 | |
| | Gross metal value | | 159.10 | |
| | Less treatment | | 7.70 | |
| | Net value per ton ........... | | 151.40 | |
| | Lb. | | | |
| Wet weight | 122,560 | | | |
| Less 6.7 percent moisture | 8,212 | | | |
| Net weight | 114,348 | or 57.174 tons at $151.40 | | $8,656.14 |
| Deductions: | Freight, $11.50 per ton | | $704.40 | |
| | Assay charges | | 6.00 | |
| | Sampling charges | | 44.90 | |
| | | | 755.62 | 755.62 |
| | Net proceeds ........................ | | | 7,900.52 |

The cost of hauling to Nipton, Calif., on the Union Pacific R.R., 22 miles west of the mine, is $3 per ton on contract. The royalty payments, based on the net smelter returns, are as follows:

| Value of ore | Percent royalty |
|---|---|
| $20 or less ........................ | 10 |
| $20 to $45 ........................ | 15 |
| $45 to $65 ........................ | 20 |
| $65 or more ........................ | 25 |

### Quartette Mine

The Quartette mine, owned by Mrs. Frank Miller of Los Angeles, Calif., has been the best producer in the Searchlight district, with a production in excess of $2,000,000. The period of greatest activity was from 1905 to 1912, when this mine was operated by the Quartette Mining Co. In recent years the property has been worked intermittently by lessees. In 1936 the Mollin Mining Co., controlled by Rex Moss of Los Angeles, Calif., erected a cyanide plant to treat the Quartette tailings. This plant superseded a flotation mill on the Quartette property.

The mine is developed by three shafts 500, 900, and 1,350 feet deep and extensive underground workings. The maximum vertical depth attained in the mine workings is 900 feet. Most of the mining equipment has been removed.

According to Ransome[28], the Quartette lode is a strong fissure zone striking about north 65° west and dipping from 20° to 70° to the south. The main ore shoot was 350 feet long and up to 50 feet in width. Formation is andesite and gneiss cut by aplite dikes. The ore consists of crushed country rock generally oxidized and carrying values chiefly in gold, with some silver associated with chrysocolla, cuprite, iron oxides, and quartz. The less frequent constituents in the ore are cerussite, wulfenite, cuprodescloizite, azurite, malachite, and vanadinite.

The flow sheet of the cyanide plant for the treatment of tailings is shown in figure 10. The all-slime cyanidation process with countercurrent decantation is employed. Capacity of the plant is 85 tons per day, and it grinds from about 50 percent plus 48-minus 8-mesh to minus 100-mesh. Cyanide at the rate of 1 pound and lime at the rate of 2 pounds per ton of solution are added to the ball mill. Precipitation is effected with zinc shavings in zinc boxes made from 50-gallon oil drums. The cyanide strength for precipitation is 1 1/2 pounds per ton of solution. To improve precipitation, lead acetate solution is added at the head of the zinc boxes. Power for milling is furnished by a 300-horsepower Fairbanks-Morse Diesel engine. Water is pumped from several shafts in the vicinity.

The Duplex mine dumps have been sampled by the Mollin Mining Co. for mill material, and it is reported that by screening the dumps through 3/4-inch mesh screen about 40,000 tons of material averaging about $6 per ton can be obtained.

---

[28] Ransome, F. L., Preliminary Account of the Goldfield, Bullfrog, and Other Mining Districts in Southern Nevada: U. S. Geol. Survey Bull. 303, 1907, pp. 69-72.

## Chief of the Hills Mine

The Chief of the Hills mine, owned by the Riverview-Cumberland Mining Corporation (Emil H. Koehl, president, Hollywood, Calif.), comprises a group of six claims (four patented) 3 1/2 miles southeast of Searchlight. In 1936 the property was leased to J. T. Woodward and associates for 10 years. From July 1936 to February 1937 Woodward, working with three men, shipped 175 tons of ore, averaging $11.77 per ton, to the Kelsey mill at Searchlight. Total production has been about $100,000.

Property is developed by several adits; the main adit is 1,100 feet long and from this adit a winze has been sunk to a depth of 165 feet. Two levels have been driven from the winze below the adit level. Total workings comprise about 3,500 feet. Mining equipment includes a Chicago pneumatic 2-stage compressor (capacity 300 cubic feet), a 6-horsepower geared hoist driven by gasoline engine, a LeRoi Rix portable compressor, blacksmith shop, assay office, and mining tools. The mill on the property is equipped with a Dodge crusher (12 by 4 inches), a 25-ton, slow-speed, Lane Chilean mill, and two amalgamation plates (5 feet wide and 10 feet long). The power plant for the mill has been removed.

The ore occurs in a shear zone in andesite porphyry. The shear zone ranges in width from 1 to 6 feet and dips about 70°. It has been disturbed considerably by faulting. Values are chiefly in gold, with a small amount of silver.

## Duplex Mining Co.

The Duplex Mining Co., controlled by Mrs. Frances Roller of Searchlight, Nev., comprises seven patented claims about 1/2 mile north of the Quartette mine. This property has been the second largest producer in the Searchlight district, with a production of about $1,000,000, most of which was made during the early days of the camp. In recent years the property has been worked intermittently by lessees. About 4 years ago an attempt was made to work the mine on a large scale, but this venture was unsuccessful. In 1936 lessees are reported to have shipped about 1,000 tons of ore to the Kelsey custom mill at Searchlight.

The mine is developed by several shafts, the deepest of which is 700 feet, and extensive underground workings.

The ore occurs in several veins ranging from 2 1/2 to 5 feet in width. The formation is principally monzonite. Values are in gold and silver, which at depth is associated with copper, lead, and zinc. The ore mined near the surface was treated by amalgamation, but at depth the ore became base, so that it was either shipped to smelters or treated in a flotation mill at the mine.

## Southern Nevada Group

The Southern Nevada group of two patented claims, owned by Mrs. Ada K. Becker of Los Angeles, Calif., and Mrs. M. L. Reynolds of Buffalo, N. Y., is about 1 mile north of Searchlight, Nev. In 1936 the property was leased to J. A. Leavitte and Ernest Sandquist of Searchlight on a royalty basis of 10 percent of the net returns. When the writer visited the property the two lessees were screening and hand-sorting gob material from the old stopes.

Property is developed by several shafts, the deepest of which is 400 feet, and lateral workings, totaling about 4,000 feet. Considerable water was encountered at about 300 feet. Equipment includes a geared hoist driven by 5-horsepower gasoline engine.

Two veins occur on the property, one vertical and the other dipping about 30° and averaging about 1 1/2 feet in width. Formation is andesite. Values are in gold, with some silver.

The stope filling is screened through a 1/2-inch mesh screen, and the undersize product is sent to the Pompeii mill owned by John R. Mendenhall. The oversize is hand-sorted. About 50 percent of the material is rejected. The screened product averages $12 per ton. The milling charge at the Pompeii mill is $4.50 per ton, and payment is made on 90 percent of the assay value of the ore. Trucking to the mill, 1 1/2 miles distant, costs 75 cents per ton, and the lessees were required to do the loading by hand shoveling. The lessees averaged better than wages.

## Pompeii Group

The Pompeii group, comprising eight patented and two unpatented claims owned by John R. Mendenhall, lies 2 1/2 miles north of Searchlight. A small tonnage of ore was mined from this property in the early days. Development comprises a shaft 330 feet deep, inclined 60°, and about 1,000 feet of lateral workings. In sinking the shaft a large flow of water was encountered at a depth of 265 feet. Equipment includes a 25-horsepower, Fairbanks-Morse, single-drum, geared hoist and a 50-horsepower, Fairbanks-Morse, gasoline engine gear-connected to a Cornish pump in the shaft. Mining is.done by hand methods. The mill on the property is equipped with a jaw crusher (6 by 9 inches), 10 stamps (850 pounds each), 2 Challenge feeders, 2 amalgamation plates (each 5 feet wide by 10 feet long), and a 40-horsepower, Fairbanks-Morse, gasoline engine.

The main vein strikes northwest-southeast and dips southwest about 50°. The ore occurs as lenticular bodies in brecciated andesite. The best values are found where the vein is traversed with seams of quarts and calcite. The demarcation between ore and waste is usually poorly defined. Values are in gold and silver. When the writer visited the property two men were employed in prospecting the old workings near the surface.

## Black Mountain Mining Co.

The Black Mountain Mining Co., owned by Ad Rickard of Searchlight, Nev., and associates, comprises 14 unpatented claims on Black Mountain 12 miles east of Searchlight and 4 miles west of the Colorado River. No production has ever been made. Development comprises an adit 250 feet long and scattered surface workings, totaling in all about 300 feet. Mining is done by hand methods.

Free gold occurs in a stringer zone 6 to 12 feet wide in hard andesite. The adit has been driven on the strike of this zone and, according to Rickard, car samples for the first 75 feet assayed from $5 to $6 per ton.

## Goldenrod Group

The Goldenrod group of five patented claims (formerly known as the Lloyd Searchlight property) is owned by John Nelson of Searchlight, Nev., and associates. It lies 16 miles by road southeast of Searchlight in an area sometimes called the Thurman district, after John Thurman who made the original discovery in this locality in 1906. In February 1937 two men were employed on the property. In 1936, 50 tons of ore, averaging $70 per ton, were shipped. In former years a small amount of ore was mined and treated locally in a small amalgamation mill equipped with two Nissen stamps.

Development comprises a shaft 200 feet deep, another 75 feet deep, and about 1,000 feet of lateral workings. Equipment includes a Gardner Rix compressor driven by 6-cylinder Buick engine, a small hoist geared to a 3 1/2-horsepower gasoline engine, a blacksmith shop, and mining tools.

The ore occurs in a quartz vein that strikes about north 60° east, dips about 80°, and is 6 to 18 inches wide. The country rock is of granitic composition. Values are principally in free gold.

## Jackdaw Group

The Jackdaw group of three unpatented claims (formerly known as the Old Roman mine), owned by J. J. McDonald of Searchlight, Nev., lies on the north side of Newberry Mountain, 18 miles southeast of Searchlight, Nev. It has been worked intermittently on a small scale for many years. Production has been probably about $15,000 in shipping ore. In February 1937 one man was working under lease agreement.

Development comprises two adits and subsidiary workings, totaling in all about 1,500 feet. Equipment includes an Ingersoll-Rand compressor (6 by 8 inches), belt-driven by a Mack truck engine. A small cyanide leaching plant on the property is equipped with a Cottrell ball mill (3 1/2 by 5 feet), jaw crusher (7 by 9 inches), and four concrete leaching tanks holding about 15 tons each. Power for the mill is furnished by a Ford automobile engine. Only a small amount of ore has been treated in this mill.

The ore occurs in a quartz fissure vein. The dip is 60°, and the average width is about 2 feet. Values are in silver, associated in places with malachite and azurite. Formation is granite.

## Homestake Group

The Homestake group of seven unpatented claims, owned by J. J. McDonald of Searchlight, Nev., lies in the southeast corner of Clark County, 9 miles north of Hiko Springs and 39 miles by road southeast of Searchlight. This mine was discovered by soldiers from Fort Mohave, Ariz., in the early sixties, and the remains of three steam plants on the ground indicate that it was exploited very early. In the early days the mine was equipped with a 20-stamp amalgamation mill. According to McDonald, production has been about $150,000. Since 1910 McDonald has worked the property intermittently on a small scale, employing one to three men. Selected ore averaging $40 per ton is hauled to Cottonwood Camp 18 miles north, where it is treated in a small mill that employs amalgamation and cyanidation.

Development comprises a shaft 300 feet deep, inclined 66°, and several adits, which, with other workings, total about 4,000 feet. There is a small gasoline hoist at the shaft. Mining is done by hand methods.

The ore is in three parallel fissure veins that strike east and west and dip about 50° to the north. Formation is pre-Cambrian granite. The main vein, on which most of the work has been done, is from 4 to 20 feet wide, averaging 12 feet, and it can be traced on the surface for several thousand feet. Values are chiefly in gold, with small amounts of silver, in a gangue of iron-stained quartz.

## Other Properties

### Searchlight mine

The Searchlight mine, comprising a group of 11 claims, owned by George W. Lichtenberger of Los Angeles, Calif., lies 1 mile north of Searchlight, Nev. It was formerly operated by the Searchlight Mine & Milling Co. In 1936 the mine was leased to J. L. Harper of Los Angeles, and in December a crew of 10 men was employed on development work. Production has been about $400,000. Property is developed by a shaft 340 feet deep and several thousand feet of underground workings. Mining operations in former years were handicapped by a large flow of water. Equipment installed by the present operators includes an amalgamation-concentration mill having a capacity of 18 tons per day, a Worthington portable compressor, and a small gasoline hoist.

### St. Louis group

The St. Louis group of eight unpatented claims, owned by W. H. Barton and associates, lies 10 miles northerly of Searchlight, Nev. In 1936 lessees produced ore valued at $22,000, which was treated at the Kelsey mill.

### Oakland group

The Oakland group of four unpatented claims, owned by Albert C. Calkins, lies 3 miles west of Searchlight. In 1936 property was under bond and lease to William G. Smith and associates and three men were employed in the latter part of the year to sink a shaft to intersect a vein exposed on the surface. Development comprises several shallow shafts, short tunnels, and open cuts, totaling about 500 feet. Equipment includes a 25-horsepower Western geared hoist, an Ingersoll-Rand Imperial No. 11 2-drill compressor, and a small amalgamation mill. The mill contains a jaw crusher (7 by 10 inches) and four Nissen stamps driven by a Dodge automobile engine, and two amalgamation plates (3 feet wide and 8 feet long). The ore occurs in fissure veins in andesite near a contact with monzonite. In sinking the shaft a flow of water, estimated at about 2,500 gallons per day, was encountered at a depth of 80 feet.

### Bay City group

The Bay City group of three unpatented claims, also owned by Albert C. Calkins, adjoins the Oakland group on the south. This property is under lease to E. C. Douglas, who produced ore valued at $1,000 in 1936. The ore was treated in the mill on the Oakland property. Development includes a shallow shaft and other workings totaling about 200 feet. Mining equipment includes a small gasoline hoist.

### Camp Dupont

In the vicinity of Camp Dupont 17 miles northeast of Searchlight, a number of claims are owned by individuals from Las Vegas, Nev., and Searchlight. Although considerable work has been done, all the properties are in the prospect stage. In 1922 the Dupont Copper Mines Co. (probably defunct) acquired the Sazarac, Bornite, and other groups of claims in this area, but no production was ever made.

In February 1937 the only activity was on the Big Shot group of two unpatented claims owned by George H. Kent of Searchlight and C. G. Duff of Las Vegas, Nev. About 35 tons of ore were mined from this property in 1936. The ore was treated in a two-stamp amalgamation mill on the Colorado River 6 miles to the east. Development work comprises an adit 150 feet long driven on a narrow vein. Mining is done by hand methods. The vein ranges in width from a few inches to 2 feet, strikes east and west and dips 60° to the south. Formation is rhyolite. Values are in gold in a gangue of quartz and crushed country rock stained with iron oxides.

## SLOAN DISTRICT

### (Limestone, Dolomite, Radium)

The Sloan district, in the vicinity of Sloan, a station on the main line of the Union Pacific R.R. connecting Salt Lake City, Utah, and Los Angeles, Calif., is about 20 miles a little west of south from Las Vegas, Nev.

via Highway 91. The only production from this area has been limestone and dolomite. The occurrences of carnotite have proved to be too small to have commercial interest as a source of radium.

The Sloan limestone deposit, discovered in 1910, was first worked in 1912 to supply lime for the treatment of gold and silver ores at Goldfield, Tonopah, and other places where the cyanide process was employed. The deposit was mined by the Nevada Rock Corporation up to 1927, when it was purchased by the U. S. Lime Products Corporation, the present owners. In addition to mining limestone, this company started to mine the dolomite that occurs above the limestone bed. The total production of limestone and dolomite from this deposit is probably more than a million and a half tons. This operation is interesting not only because of the magnitude of the deposit but because it is in the desert region far removed from the centers of population where lime is used. Los Angeles, the principal consuming center, is 280 miles from Sloan.

## United States Lime Products Corporation

The U. S. Lime Products Corporation employs an average of about 50 men in the annual production of about 50,000 tons of crude limestone and dolomite and about 25,000 tons of lime and dolomite products. At Sloan the company operates a plant for converting the dolomite and limestone into lime, lime-hydrate, dolomitic lime, and dolomitic lime-hydrate. Crude limestone is shipped to southern California for use in the refining of sugar and in open-hearth steel furnaces.

Plant equipment includes a Blake-type crusher (9 by 38 inches), two rotary kilns (7 and 8 feet, respectively, in diameter and 100 feet in length), four vertical kilns, hydrators, steel silos, trommels, elevators, bagging machines, and other equipment for a complete plant. Power for the plant is furnished by Diesel engines generating electricity. The company also maintains a control labratory at Sloan for making chemical and physical tests on the lime products in order to maintain standards of quality.

The limestone and dolomite beds form an isolated mountain having a maximum elevation of 1,000 feet above the surrounding terrain. The limestone bed is about 150 feet thick and lies nearly horizontal. The overlying dolomite has an average thickness of about 600 feet. Both the limestone and dolomite are dense and uniform in composition so that selective mining is not necessary. The composition of the limestone and dolomite averages as follows:

| Limestone | Percent |
|---|---|
| $MgCO_3$ | 1.72 |
| $SiO_2$ | .72 |
| $Fe_2O_3$; $Al_2O_3$ | .45 |
| $CaCO_3$ | 97.11 |
| Total | 100.00 |

| Dolomite | Percent |
|---|---|
| $MgCO_3$ | 44.35 |
| $SiO_2$ | .14 |
| $Fe_2O_3$; $Al_2O_3$ | .37 |
| $CaCO_3$ | 56.14 |
| Total | 100.00 |

The limestone is mined by quarrying and shrinkage stoping. Originally the limestone bed formed a prominent cliff so that it could be mined by quarrying with little dilution from the overlying dolomite. In recent years, however, the amount of overlying dolomite quarried with the limestone became excessive and preparations were made to mine the limestone by shrinkage stoping. For this purpose development headings 12 feet and 8 feet in width are driven at the base of the limestone bed. The shrinkage stopes are about 30 feet wide, 80 feet high, and up to 250 feet long. Pillars left between successive stopes average 20 feet in width. To facilitate drawing off the broken ore from the stopes, drifts are driven into the pillars, and from these drifts small crosscuts tap the stopes at convenient intervals. At the time of writer's visit the shrinkage-stoping operations were in the experimental stage, and all the details had not been worked out completely.

The stopes are advanced by drilling on broken rock. Holes are drilled from 8 to 12 feet deep with jackhammers and 7/8-inch hollow hexagonal steel with detachable bits. Blasting is done with 40-percent gelatin dynamite and No. 6 detonaters.

The broken limestone is shoveled off the floor of the level by hand into 1-ton mine cars. Eventually, mucking machines may be employed. Tramming is done by hand. The crushing and lime-burning plants are below the quarry floor, so that the limestone is transported by gravity trams of the 3-rail type.

### Carnotite Deposit

In 1915 carnotite was discovered in a railroad cut several miles south of Sloan by N. E. Williams of Las Vegas, Nev.

The carnotite, associated with calcite and manganese oxides, occurs as thin coatings along joint planes in rhyolite. Very little prospecting work has been done, and the deposits are too small to be of commercial interest.

## SUNSET DISTRICT

(Gold, Feldspar)

The Sunset district is in southern Clark County near the California boundary line 4 1/2 miles east of Desert, Calif., a station on the Los Angeles & Salt Lake R.R. This district adjoins the Crescent district on the north. The only productive property in this area has been the Lucy Gray mine, discovered by Lee Bright in 1905. This property is said to have produced about $50,000 and, judging from the tailings pile at the mine, comprising about 4,000 tons, this is probably substantially correct. The property formerly was equipped with a Lane slow-speed Chilean mill and cyanide leaching equipment.

Deposits of feldspar in pegmatite dikes were located in this area in 1936, but no production has been made.

## Lucy Gray Mine

The Lucy Gray mine comprises nine unpatented claims owned by the Bright brothers, John and Will, of Los Angeles, Calif. The property was last worked under company management in 1920, but since that date lessees have made sporadic shipments. In February 1937 the property was under 10-year lease to J. W. Collis and J. H. Roese of Los Angeles, who were preparing to equip it. The lease specifies royalty payments of 10 percent on the net mill or smelter returns.

Development includes a two-compartment vertical shaft 300 feet deep with main levels at 100-, 200-, and 300-foot elevations, and five short adits none of which is over 100 feet long. Total workings comprise 3,200 feet. Most of the equipment has been removed from the property.

The ore deposits occur as pockets in shattered zones in a granitic gneiss formation. The values are principally in gold, with minor amounts of silver. The gangue is chiefly jaspery quartz and iron oxides.

## Feldspar Deposits

Feldspar occurs in the Sunset district 4 miles east from Desert, Calif. The deposits are covered by three unpatented claims located by George Noltkamper of Nipton, Calif., in 1936. Very little work has been done on the claims.

The feldspar occurs in numerous pegmatite dikes varying from a few feet to 30 feet in width. In most of the dikes the feldspar is intimately associated with quartz and biotite. However, in one dike averaging 30 feet in width and outcropping for a length of 500 feet masses of fairly clean feldspar are exposed.